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AGILE BUSINESS PRACTICES DEMONSTRATION PROJECT

Automotive Industry Action Group
26200 Lahser Road
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November 1996

Final Report For the Period 30 January 1995 - 30 November 1996

Approved for Public Release; Distribution is Unlimited.

Manufacturing Technology Directorate
Wright Laboratory
Air Force Materiel Command
Wright-Patterson Air Force Base, Ohio 45433-7739

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This technical report has been reviewed and is approved for publication.

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13. ABSTRACT

The Manufacturing Assembly Pilot (MAP) project is an effort to improve material and information flow within the automotive industry. A group of companies came together at the Automotive Industry Action Group (AIAG) to identify improvements and test them through pilot application. Business metrics were tracked to validate the impact of the improvements. MAP has identified common technologies and business practices that offer significant benefit for individual companies and supply chains as a whole.

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PREFACE

This is the final report of the Manufacturing Assembly Pilot (MAP) project. This project was funded in part by the United States Department of Defense, Advanced Research Program Area (ARPA) as an Agile Business Practices Demonstration Project. This project was proposed and subsequently awarded to the Automotive Industry Action Group (AIAG) under Broad Agency Announcement ARPA/SSTO BAA-94-31. This project was managed by the U.S. Air Force Materiel Command, Wright Laboratory (WL/MTIA). This Final Report satisfies the deliverable referenced in Article 14,C of cooperative agreement number F33615-95-2-5518.

The AIAG is a not-for-profit trade association of North American vehicle manufacturers and suppliers. The mission of the AIAG is to improve the productivity of its members and the North American automotive industry. The intent of this project is both to provide direct benefit to automotive manufacturing and to identify improvements that benefit other industries including defense suppliers.

This project focuses on improving the flow of information and material during the order fulfillment process where multiple production releases are issued against a purchase order. Improvements entailed both electronic commerce technologies and improved business practices applied throughout the supply chain. During the course of the project, these improvements were validated through pilot implementation down four tiers of an automotive seating supply chain. Results indicate significant impact on information lead time and other measures, which is expected to reduce cost in the industry of about a billion dollars. The big three automobile manufacturers now require the adoption of key MAP improvement recommendations within their supply chains and the AIAG is supporting adoption through promotion, training, and reference materials.

Completion of this project was a cooperative effort between the following organizations:

- AIAG, Project management and industry interface
- Air Force ManTech, Government Contracting Agency
- Participating Manufacturing Companies, including: Ford, General Motors, Chrysler, Johnson Controls, Lear Favesa, Douglas and Lomason, Collins & Aikman, Millikan & Company, Textileather, Technotrim, Atwood Automotive, R-R Spring, Rockford Spring, Specialty Screw, Dudek & Bock Spring, and Canadian Fab
- Industrial Technology Institute, Contracted services provider
- Wizdom Systems, Contracted services provider

Further information about the MAP project can be found on the AIAG's webs site: http://www.aiag.org/

1. Introduction

1.1 Abstract

The Manufacturing Assembly Pilot (MAP) project is an effort to improve material and information flow within the automotive industry. The project was started in 1994. A group of companies came together at the Automotive Industry Action Group (AIAG) to identify improvements and test them through pilot application. Business metrics were tracked to validate the impact of the improvements. MAP has identified common technologies and business practices that offer significant benefit for individual companies and supply chains as a whole.

1.2 Overview

The objective of the MAP effort is to improve the quality of information flowing down the supply chain and move it quickly, as quickly as a day per tier, from the OEM to the last supplier in the chain.

The MAP Supply Chain is typical within the automotive industry. World-class practices are in place between OEM and first-tier supplier, in this case Johnson Controls. There is single-piece flow manufacturing for seats. Seats are delivered in sequence so they can be unloaded and installed directly as cars or trucks move along the assembly line. Inventories are almost non-existent in this environment, quality is high, and material is moved to the next manufacturing operation "just-in-time."

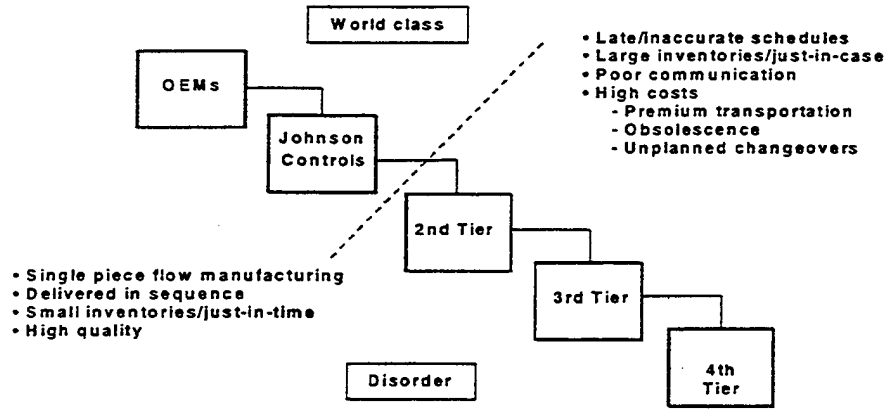

Figure 1-1. Characterization of First Tier Suppliers

Contrast that with the disorder in material flow that exists below the first tier. Scheduling information is often late or inaccurate, large inventories are carried just in case there is a problem. Little or no communication between suppliers, coupled with the problems mentioned above, leads to higher costs in premium transportation, obsolete material, and the costs of unplanned changeovers in manufacturing in order to provide on-time shipments. Material flows because suppliers have a "do whatever it takes!" attitude, and the cost of doing business in this way is buried in the supply chain. The dichotomy between supply relationships above and below the first tier is depicted in Figure 1-1.

Figure 1-2 is a chart of all sixteen companies in the seat supply chain participating in the project and the information and material flows between them. Notice the two different chains below Johnson Controls at the first tier. On the right, highlighted by the dark arrows are the hardware suppliers, and on the left, the gray arrows represent the soft-trim part of the supply chain. If it looks complicated, that's because it is!

1.3 Methodology

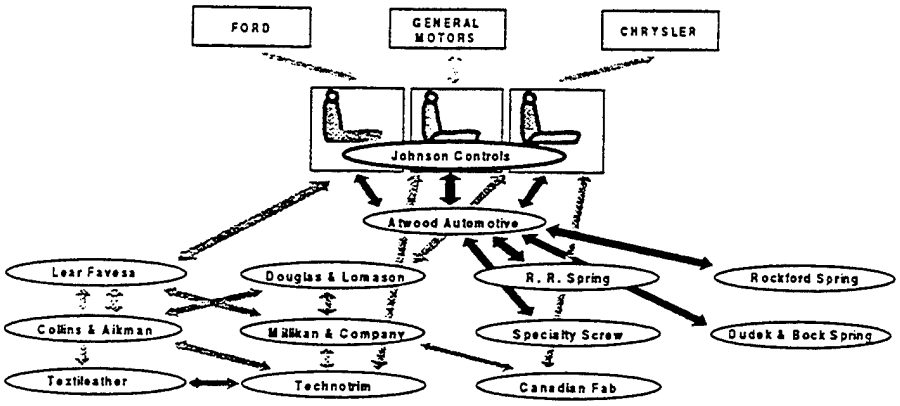

Figure 1-2. The MAP Supply Chain

AIAG decided to attack the situation by considering the supply chain as a system. This allowed for the identification of improvement opportunities that would impact the entire supply chain. These improvements led to a number of recommendations from a team made up of representatives of the companies participating in the MAP project. The group's recommendations touched on all stages of information flow, as depicted in Figure 1-3.

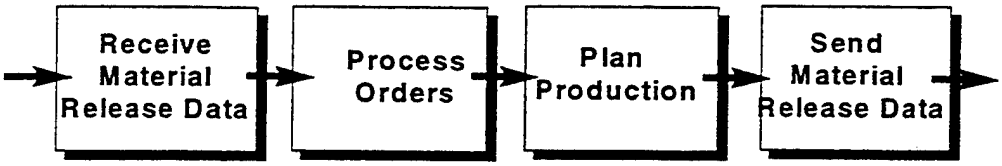

Figure 1-3. Production Release Process Flow

The intent of the recommendations is to flow information more quickly. An agile supply chain must be able to move the full planning horizon from the top down to the lowest tier without having information truncated or distorted at any tier along the way. EDI is the primary method for communicating both long-term

planning and short-term scheduling information to minimize information flow lead time. Electronic mail or (e-mail) is used for ancillary communications is required. To make this all work, business practices must be re-engineered to allow lead-time compression. Customers and suppliers must communicate and understand each other's business processes. Only then will you see positive change in the supply chain. Figure 1-4 shows the kinds of time savings expected at each stage of information flow.

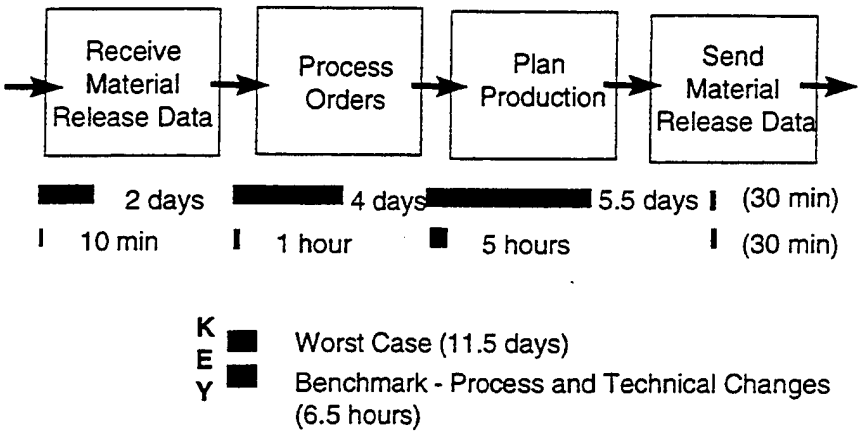

Figure 1-4. Benchmark Lead Time Improvement

Through MAP these improvements have been implemented down the supply chain. This work has demonstrated some important lessons regarding implementation of new communication technologies and re-engineering the business practices that support them including the following:

- Suppliers are resource constrained, and solutions must be low cost with minimum impact on staff time.
- Many suppliers have similar business structures, so solutions can be built on common templates.
- In many cases, suppliers are constrained by existing business computer systems. These systems not only limit the integration of new information technologies, but also inhibit changes in current business practices.

1.4 Metrics

As a result of implementing the recommended changes, suppliers will possess accurate and timely material requirement information. The MAP project team has selected a set of metrics to provide answers to two questions.

1. Are the changes having the desired impact on the supply chain?
2. What results can be used in a business case to promote broad adoption in other supply chains?

These metrics demonstrate the kind of performance improvement that can be achieved. Improvements were measured by analyzing changes in the cost of premium freight, number of on-time shipments, rate of inventory turnover, and number of unplanned changeovers in manufacturing. Figure 1-5 depicts relationships among these variables.

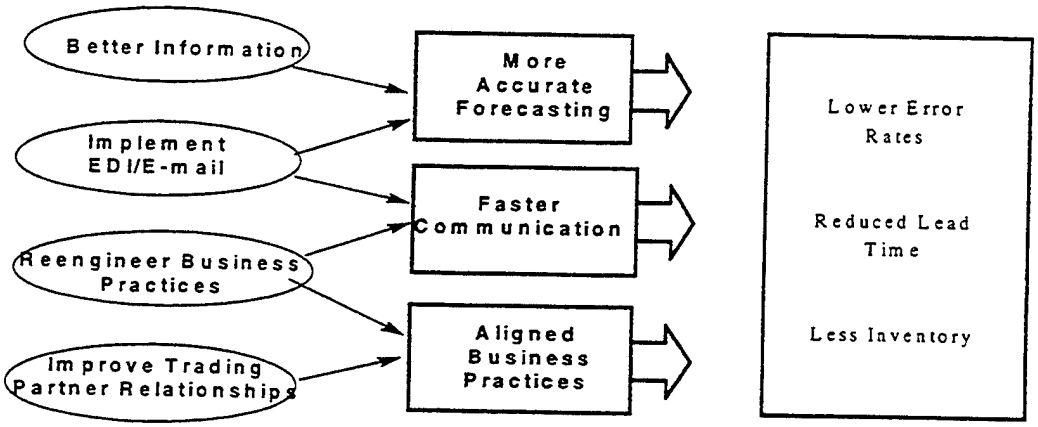

Figure 1-5. MAP Benefits

Figure 1-6 and Figure 1-7 show how dramatically the lead time has been reduced in the MAP supply chain.

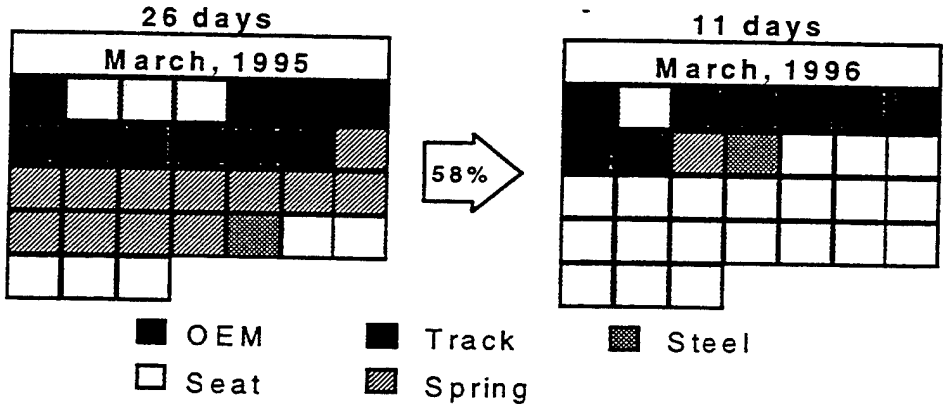

Figure 1-6. Lead Time Improvement in Hardware Chain

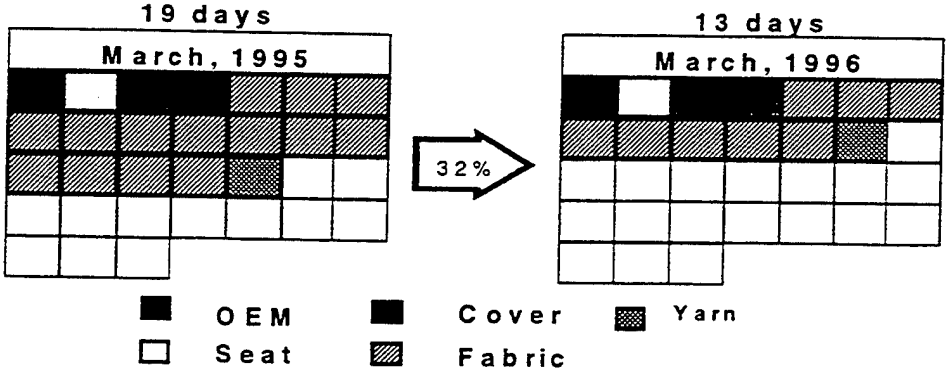

Figure 1-7. Lead Time Improvement in Soft Trim Chain

1.5 Industry Adoption

The key to industry adoption are the strategic initiatives of the automobile manufacturers along the business case and implementation experience from the MAP pilot. When policy is driven by sound business case data along with proven experience, broad adoption is not only possible, but probable. Companies will decide to make these changes because education and training are available, the costs and benefits are known, the risk can be managed, and customer and supplier goals are supported. An overview of the recommended approach to developing adoption plans is presented in Figure 1-8.

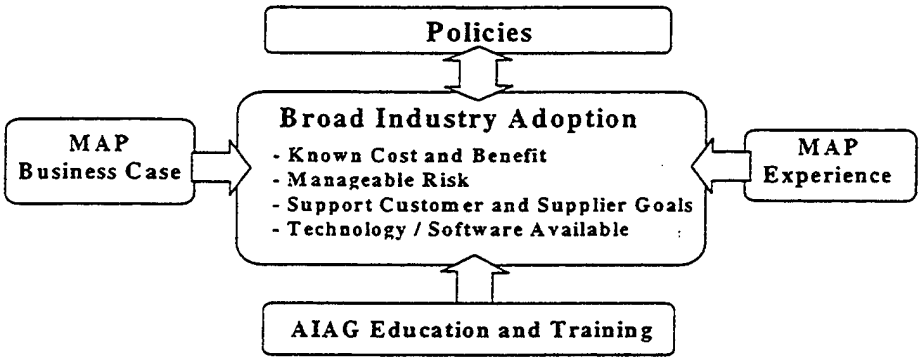

Figure 1-8. Broad Deployment Strategy

The Ford Motor Company initiated a material system requirements program called MS-9000 with their suppliers, which is built on several of the MAP recommendations and business practices. This led all the OEMs to work together to initiate a substantial, positive change. Ford, Chrysler and General Motors have agreed on and communicated a common set of requirements for EDI implementation to their first, second, and third tier suppliers.

This same kind of success can be realized in other industries and AIAG is committed to working together to transfer what has been learned from MAP, in a form that would be useful in their initiatives.

2. Description of the Problem Addressed during This Effort

2.1 Role of AIAG

The Automotive Industry Action Group (AIAG) is a not-for-profit trade association of North American vehicle manufacturers and suppliers. The mission of the AIAG is to improve the productivity of its members and the North American automotive industry by providing an organization to:

- Foster cooperation and communication between customers and their suppliers to improve business processes.
- Identify, prioritize, and address existing and emerging common issues and apply new and current technology to increase the efficiency of the industry.
- Promote a sense of urgency in adopting developed business practices.
- Cooperate and communicate with other industry, government, educational, and technical organizations.

Under the auspices of AIAG, volunteers from over 1300 member companies tackle industry issues in supply, manufacturing, engineering, quality, and finance. Working together, they investigate the benefits of finding commonalities in new areas, examine established business processes with an eye toward improvement, and compare procedures to determine best practices.

AIAG member companies reap immediate benefits while the North American automotive industry as a whole reaps long-term rewards. AIAG members play a unique role in the development of new technologies and the standards that govern their usage. By providing the perfect forum for initiating proactive planning and improving trading partner relationship, AIAG membership offers:

- A neutral environment for discussing issues
- Networking opportunities between customer and supplier companies
- A link to the development of customer requirements. AIAG supplier members are never surprised by requirements -- they help shape them
- Exposure to other member companies' business strategies and implementation successes
- Working solutions to critical cost problems
- Training to sharpen leadership and project management skills
- Complimentary copies of AIAG's standards/guideline publications

In addition to acting as an information resource and solutions clearinghouse, AIAG also provides the industry with a strong voice to allow members to:

- Participate at national industry, standards and technology forums
- Set the direction for company and industry changes

2.2 Pre-award Efforts

The concepts for the MAP project were developed initially at the Industrial Technology Institute (ITI), in Ann Arbor, Michigan. ITI approached the AIAG in late 1992 for assistance in exploring the potential for application of electronic data interchange techniques (EDI) within multi-tier automotive supply chains. AIAG accepted the ITI proposal and worked with ITI during 1993 to plan the project and recruit participants.

In order to keep the project within bounds in terms of both time and cost, the scope of the project was initially limited to two key components of finished seating – manual seat adjusters and seat covers. As a result, the pilot supply chain has two separate branches below the first tier supplier of finished seating. One

represents seat covers and fabric suppliers, The other represents seat adjusters and the related hardware suppliers.

The project design team established the following overall objective:

> Improve inter-company communications and practices in order to optimize material and information flow within the pilot supply chain.

The project was approved by the AIAG Board of Directors in December 1993 and kicked off early 1994 with management meetings and training of the participants in business process modeling. The first phase of the project called for an in-depth study of current practices and development of specific recommendations for new and improved practices. Wizdom Systems was selected to perform this study to take advantage of their expertise in the use of the IDEF modeling methodology and their experience in applying that methodology within the automotive industry.

The in-depth review of current practices began in February of 1994. All of the participating companies were visited and current practices were reviewed and documented. The analysis of current practices and the development of recommendations for new and improved practices have been accomplished using the AIAG workgroup structure along with sub-committees doing detailed analysis and recommendation work in specific areas.

The workgroup/subcommittee activity produced nine broad recommendations for new and improved business practices. The recommendations call for greater use of electronic communication for faster, more accurate and readily usable information. The recommendations call for taking advantage of information already being communicated by passing along information currently provided by OEMs or by the first tier supplier but not passed all the way down the supply chain. Finally the recommendations call for communication of some information not currently being shared. The overall flavor of these recommendations is that of customers and suppliers working together in a more active partnership to ensure the efficient and effective functioning of the total supply chain. The recommendations are as follows:

1. All trading partners should make use of at least a minimum number of standard EDI transaction sets with their customers and suppliers. Additional transaction sets are recommended and should be adopted either with initial EDI implementation or over time as supported by the specific business case.
2. E-mail should be used for non-EDI communication with trading partners, i.e., for exception and supplemental communication so long as its use will meet the immediate needs of the situation.
3. Customers should make special, supplementary contact with their immediate suppliers if they make unusually large change in material requirements within the early weeks of the schedule. This contact would be person-to-person, not EDI. The intent is to provide and alert to the supplier that a situation exists which can be expected to generate substantial added cost and waste if there is any delay in the automated system or in the human use of and reaction to that system.
4. The full OEM planning horizon should be passed down through the supply chain. That is, all suppliers should pass whatever number of weeks of material planning information they receive on down to their immediate suppliers.
5. The material requirements reflected in the weekly OEM material release should also be communicated directly to lower tier suppliers with extended lead time requirements for their use in long term planning. The information should be communicated either by the OEM or by the first tier supplier directly to the lower tier supplier.
6. OEM operating plan information , i.e., information such as vehicle planning volumes by car and truck line and plant work schedules, should be communicated to suppliers requesting that information.
7. Customers should develop and deliver, in cooperation with their suppliers, training programs on materials management and related information management practices for supplier personnel.
8. Internal business systems should be developed initially or modified to make use of EDI transaction sets directly and automatically. Printing out and re-keying of information received via EDI adds cost, delays, and errors.

9. Trading partners should adjust internal systems and procedures where necessary to allow release of material requirements to their suppliers as soon as possible and operationally practical after receipt of material releases from their customers.

2.3 Industry Conditions

The objective of the MAP effort is to improve the quality of information flowing down the supply chain and move it quickly, as quickly as a day per tier, from the OEM to the last supplier in the chain. The automotive industry comprises a huge network of suppliers who work together, building the components that comprise cars. This industry is characterized by production volumes of over 15 million vehicles per year, across an array of brands, models, and options. This is a highly competitive industry where the pressures on cost and time are extreme. Within this context the automotive industry has evolved practices that characterize *best practice* for U.S. manufacturing. Still, there is a need and determination for continued improvements in the effectiveness of the supply chain.

2.3.1 Current Technology Status

This section describes the current situation regarding the use of MAP recommendations in industry.

EDI has been in use by the automotive industry for many years. In fact, automotive use of EDI has led many other industries. Early applications of EDI used proprietary formats, over direct connections, to connect automobile companies with their larger suppliers. Over time, the industry has changed to support common X.12 formats and use commercial network services. Using Value Added Networks (VANs), suppliers can pass transactions to a system which will store and forward the transaction to the appropriate trading partner. Bridges exist between the major commercial networks, such that transactions can flow from a supplier firm on one network to a trading partner on a different network. The AIAG has been instrumental in establishing common transaction formats and business practices to enable interoperability of information passed between trading partners.

In the past, adoption of EDI technology has been limited to larger companies, higher in the supply chains. This legacy results from the early adoption of EDI by high volume, upper tier, suppliers. It was the bigger, first tier, suppliers who had the customer demand and the technical capability to adopt EDI. At that time, solutions were custom developed and integrated into their largely custom manufacturing software. Later, makers of more-standardized manufacturing software added EDI modules as options. These systems were complex and expensive, making them only appropriate for larger firms.

The VANs were eager to find low cost ways for suppliers to be EDI capable. Some VANs would do a simple conversion of an EDI transaction to a FAX. In this way, the supplier could receive information that was sent, electronically, from their customer. With the advent of the personal computer, companies could adopt *stand alone EDI*. Stand alone EDI is sometimes referred to as "rip and read EDI." This is because the stand alone system still requires that information be printed out on the EDI system and re-keyed into the manufacturing software. The same is true for information flowing in the other direction. Information from the manufacturing software is printed out and then re-keyed into the EDI system. This re-keying of information is a non-value-added cost and a frequent source of errors.

Use of off-the-shelf manufacturing software has increased over recent years. This increase is especially seen in smaller suppliers that had previously used paper systems and/or spreadsheets. The manufacturing software typically includes modules for order entry, scheduling, purchasing, inventory, shipping/receiving, invoicing, and accounting functions. There is a segment of the manufacturing software business that targets small and medium-size, high volume, manufacturing firms. Software companies that serve this market are typically small companies themselves. There are hundreds of these software companies with little market dominance. Currently, most of these software packages do not offer EDI modules. This reflects a general feeling among smaller suppliers that EDI is mainly for large companies and not important for them.

Within a supplier, business practices follow the strategy defined by the manufacturing software. The manufacturing software designer had specific ideas how information would flow and how staff would interact with the data. In this way manufacturing software can constrain the adoption of business practice changes.

The manufacturing environment is changing. In part due to the success of MAP, automobile companies and their large first tier suppliers now understand the value of EDI and improved business practices when applied throughout the supply chain. As a result, programs are now in place to require the adoption of EDI down the tiers of supply.

2.3.2 Critical Success Factors

This section describes the business drivers of the change process.

Improvement of information flow in a supply chain is a system-wide problem that extends beyond the scope of a single industry. The solution, however, is accomplished at a much more local level. Somewhere, at some plant, a manager needs to be convinced to invest resources and make improvements. This change event must be replicated throughout the supply chain, such that it becomes the norm. As such, success depends on both supporting change at the plant level as the method to promote broad industry adoption.

It is a natural flow for new technologies to be first adopted by larger firms and then smaller ones. Larger firms can afford the high cost and risk associated with new technology. Later, as the technology matures, it is refined and the economies of scale reduce cost. As early adopters, the large firms also prove out the business value of the new technologies. Left to its own, the adoption of new technology, by small suppliers is slow because it is only promoted by vendors. In the case of the MAP, upper tiers in the supply chain understand the value of broad adoption and thereby are motivated to accelerate adoption throughout the supply base.

This issue is then: What strategy can accelerate adoption of these technologies broadly throughout the supply chain? The crucial fact is that change happens at a local, even personal level. At some point a person needs to want change and be successful implementing that change. From a supply chain point of view, we can only develop systems to influence that decision and assist implementation.

Small manufacturers, and particularly automotive suppliers, share common characteristics. Some gross generalizations include:

- Very independent, competitive, and harried personalities
- They believe their company is more unique than it is
- They have a shopping list full of things they know need to be improved, but limited resources (time, talent, cash) to solve them.
- Are using computers in various areas of their business but little system-wide integration
- Manufacturing software is expensive, difficult to change, and poorly supported

Business owners decide to make changes based on two criteria. The first criteria is economic; Does the change reduce cost or improve income enough to justify costs? Manufacturing is a capital intensive business, and these companies understand the need to spend resources. On the other hand, successful suppliers are often cash poor as they grow. The second criteria is strategic: Is the change needed to stay in business? Customers, unions, and the government can all impose changes on the organization. These strategic changes can be mandated requirements or more subtle suggestions. For example, a company may change to returnable packaging because a customer encourages it.

Formal cost justification of changes is seldom practical. Manufacturing cost areas are not understood well enough to identify both the direct and indirect cost saving related to a change. As such, managers generally make economic cost justification based on the reported experience of others and adapting those results to their own situation. For small and medium size suppliers, an ROI (return on investment) evaluation, contains as much case study as numerical analysis.

Automotive parts manufacturing is an intensely competitive business. Upper tier suppliers are actively working to shrink the number of their suppliers. This means that some suppliers are growing at painful rates while others are failing. Every firm tries hard to stay in the game. Suppliers are also starting to rationalize their customer lists. Suppliers understand they can better serve a smaller number of customers and align their capabilities with their customer needs. While suppliers often resent new requirements from

their customers, they understand the competitive necessity to make the changes. It should be noted here that the automotive industry has lost some credibility with suppliers regarding supplier development programs. There have been a number of instances where customers have stated a requirement but not followed through with consistent purchasing practices. Then, even when suppliers made changes to align with stated customer requirements, no competitive advantage was realized. Because of this, some suppliers protect themselves by delaying changes until after the customer has shown they are serious about the requirement.

Even when the supplier believes there is sufficient economic and/or strategic reasons to change, there are additional barriers that must be overcome before successful adoption. There must be:

- enough resources (cash, staff time)
- confidence in successful implementation
- products from vendors
- uninterrupted normal operations

Successful (growing) companies are making a great number of changes. Any individual improvement must be evaluated against other potential improvements, prior to commitment of resources. There is never enough time, money, or staff to implement all improvements; even when each seems justified on its own merit. The company management must prioritize potential improvements to implement those improvements that have high impact and high confidence of success. This confidence of success is dependent on solutions to the above listed barriers.

Regarding the need for cash, if suppliers have realistic estimates for cash requirements, they can generally plan for and meet the need. The cash requirements may require the changes to be delayed to phase into an appropriate time in the business cycle.

Regarding the need for staff, most small suppliers have few (if any), degreed engineers to implement new technologies. Existing staff is generally quite busy keeping up with operational requirements. Therefore, there is little staff time available to bring in new systems. This problem is made more difficult because of the nature of Electronic Commerce implementation projects. These projects generally impact many parts of the organization. As such, the implementation staff needs a broad understanding of the business and the computer systems used. There is an opportunity to solve the staff resource barrier, however. While there is a general aversion to using consultants in core business systems, most firms do use their computer system's vendor as adjunct technical staff.

Suppliers need to be confident that improvement implementation will be successful in their operation. They realize that they can not afford to waste scarce resources. They have all been burned before by good sounding salesmen or energetic staff. Most often their strategy is to let others brave the bleeding edge of new technology. They are content to let others demonstrate that the improvement can work. There is a well fed grapevine where suppliers can hear about the success or failure of other suppliers. In addition to hearsay, suppliers use trade associations and their customers to provide input about the maturity of new technologies. These forums provide a vehicle for suppliers to hear about examples of successful implementation. As the suppliers hear about other implementations, confidence is developed for their own effort.

Suppliers adopt new technology in the form of products from vendors. They depend on the vendor to provide and support the solution. Suppliers believe that their core competency lies in manufacturing operations, not supporting enabling technologies. Suppliers want to buy solutions from established vendors as standard "off-the-shelf" products. This desire for standard products is closely related to solving other barriers to adoption including limited resources and confidence of successful implementation. Standard products use less resources because of the economies of scale, they are less expensive. In addition, standard products take less effort to install and others can help support them. Standard solutions are lower risk because the vendor has worked out problems at other firms during product development.

Finally, suppliers need to continue normal production operations while improvements are implemented. For most improvements, this barrier is solved by running new systems in parallel with existing systems. The results of both systems are compared to identify problems. When the supplier has confidence in the new system, normal operations will "cut over" to the new system. The cut over is often coordinated with

suppliers and customers that may be affected. In this way problems will be identified and resolved quickly. Because it means extra effort and risk with customers, suppliers minimize visible changes.

2.3.3 Information Flow Description

When Ford sends material releases to suppliers, the weekly "buckets" that have the material shipping requirements are represented in "cumulative" quantities calculated from the start of the model year. The cumulative requirements also contain adjustments for returned, missing, and defective materials and overshipments. The supplier compares the cumulative requirements to the cumulative shipments to determine the quantities to be shipped during the time period to meet Ford's material needs. The supplier performs the following tasks when processing the release:

- Interpret the figures for each release period
- Break down the cumulative requirements into discrete shipping quantities
- Determine the shipping dates
- Schedule material pick-ups with the carrier
- Make adjustments in shipping quantities for returned, missing, or defective material
- Compare requirements to shipments and receipts to determine current material status
- Calculate cumulative shipped quantities for the Shipping Notice
- Recognize any increases or decreases in future requirements from previous releases
- Schedule operations to fabricate sufficient material to meet requirements
- Establish material or component ordering quantities and lead times for planning figures
- Determine if the material is going to be needed past the current model year

Proper interpretation and use of the release quantities prevents under and overshipment, reduces expediting and set-up costs, allows the supplier to better plan purchasing decisions from sub-suppliers, prevents material claims at end of model year, and reduces material claims in case of engineering changes. The largest saving a supplier could realize is reduction of raw material, work-in-progress, and finished goods inventory by using the release information to provide tighter control over the order, manufacturing, and shipping of material.

2.4 Importance of Solving This Problem

The extended enterprise is widely recognized as the competitive engine of the future. This vision holds that large and small firms will quickly come together to design, produce, and market new, innovative products. Today many industries are realizing a competitive advantage by relying on the talents and capabilities of the their suppliers. Further progress can only be made if we learn to organize supply chains into efficient design and production teams and extend business process reengineering to supply chains. The MAP project tested these concepts by implementing compatible systems and practices along a 16-firm, four-tier supply chain in the areas of material releasing, scheduling, and shipping.

By reviewing current practices and identifying opportunities for improvement, the MAP project was able to implement changes that directly benefited all members of the supply chain. These changes improved their ability to communicate and conduct electronic commerce with a wide variety of firms. The MAP project successfully demonstrated the following:

- Innovative approaches to planning and implementing changes in business practices and communication lead to real improvements in business performance and profitability across an entire supply chain.

- New approaches to modeling and performance evaluation can capture the dynamics of supply chains.
- New approaches to providing business justification for adopting new "team-wide" business practices can be established.

By leveraging the strengths of the power of information technology and the innovative capability of the small members of the supply chain, significant savings and increases in responsiveness were made throughout the supply chain. These accomplishments were achieved by reengineering the business relationships and communication links along the length of the supply chain, from original equipment manufacturers to the lowest tier in the chain.

The major value of the MAP project is that it has successfully demonstrated measurable achievements that can be deployed to impact agile material flow and reconfigurable logistics. The demonstrated improvements in business practices and new technologies are applicable to many supply chains in the automotive industry and other durable goods manufacturing industries, including defense supply chains.

3. Description of the Work Performed and Its Benefit to "Agility"

3.1 Implementation of the Recommendations

3.1.1 Johnson Controls, Inc. (JCI)

Tier: One
MAP Product: Seat
Location: Varies by plant, see below

JCI Corporate Profile:

Johnson Controls is a major supplier of automotive seating, batteries, control systems, and services for commercial buildings. Roughly half of JCI's business is in the automotive industry. In 1995 Johnson Controls manufactured 34% of all car seats made in North America. Johnson Controls' seat assembly operations operate at the world-class level of performance, delivering seats Just-In-Time (JIT) and in Sequenced-Part-Delivery (SPD) to OEMs.

Three Johnson Controls seat assembly plants are included in the MAP supply chain.

Plant	Customer
JCI Orangeville, ON	Chrysler, Bramalea, ON assembly plant
JCI Strongsville, OH	Ford, Avon Lake, OH assembly plant
JCI Ossian, IN	GM, Ft. Wayne, IN assembly plant

In addition, JCI owns two second tier seat cover plants in the MAP supply chain.

Tier:	Two
MAP Product:	Seat cover
Plant	Customer
Greencastle, IN	Technotrim
JCI Orangeville, ON	Canadian Fabricated Products

Implementation Support Provided:

During the fall of 1995, consultants from Wizdom and ITI conducted site visits to each of the JCI plants to perform an implementation requirements analysis and assist in the preparation of implementation plans. All Johnson Controls plants were equipped with fully functioning integrated EDI capability. Due to the advanced state of JCI operations relative to project recommendations, one master plan was produced for all of the JCI plants. Generally, there was minimal technical assistance required at any of the JCI plants. In order to determine the opportunities for process improvement, consultants from Wizdom worked with JCI

business analysts and plant personnel at each of the JCI plants. Process assessment was conducted based upon interviews with plant managers and personnel involved in key processes. Process analyses identified areas for improvement at three of the five JCI plants.

Summary of Scope of Process Improvement Issues at JCI Plants:

JCI Orangeville:	Fully compliant with MAP recommendations. No implementation support provided. Metric training and validation support services provided.
JCI Ossian:	Fully compliant with MAP recommendations. No implementation support provided. Metric training and validation support services provided.
JCI Strongsville:	Wizdom site visits identified specific opportunities for process improvement. JCI committed to pursue improvement with internal resources. Metric training and validation support services provided.
Technotrim:	Site visit identified opportunities for reductions in lead time and streamlining of processes. JCI committed to pursue improvement with internal resources. Metric training and validation support services provided.
Canadian Fabricated Products:	Site visit identified opportunities for reductions in lead time and streamlining of processes. JCI committed to pursue improvement with internal resources. Metric training and validation support services provided.

Key Issues and Lessons Learned:

- The ability of each JCI plant to send timely, accurate information to its suppliers is dependent on the quality of information received from its customers.
- The quality of release information tends to vary by both customer and part number.
- A relatively small number of "problem parts" cause a majority of downstream problems, errors, re-work, and cost. Finding is consistent with the 80-20 rule.
- A company's requirement for confidentiality can limit the efficacy of 'extended enterprise' analyses and supply chain-level process improvement. Initial process analysis revealed opportunities for improvement that could improve the quality of information provided to suppliers from a specific JCI plant. While JCI plant management and personnel expressed interest in receiving assistance from Wizdom and the AIAG, upper level JCI management decided to conduct process improvement with internal personnel. At this point, in March 1996, implementation support from AIAG and Wizdom ceased.

3.1.2 Douglas and Lomason

Tier: Two (Trim)
MAP Product: Seat Cover
Location: MIS department: Farmington Hills, MI
Warehouse operation: Orangeville, ON

Douglas and Lomason Corporate Profile:

Douglas and Lomason Company is a worldwide supplier to the automotive industry of seating systems, frames, covers, foam, and mechanisms. Douglas and Lomason Company currently employs 5,900 associates throughout the United States, Canada, Mexico, Europe, and China. The MAP project, i.e., sales of seat covers to JCI Orangeville, represents roughly 8% of Douglas and Lomason's business.

Implementation Support Provided:

At the outset of the implementation phase of the MAP project, Douglas and Lomason possessed integrated EDI capabilities. The technical capabilities were augmented by the existence of efficient business processes that allowed for the receipt, processing, and sending out of material release information in three hours—well within the 24 hour cycle time goal.

Douglas and Lomason achieves its quick processing time as a result of:

- A relatively simple Bill of Material that enables speedy MRP processing.
- Efficient processes: Douglas and Lomason personnel review exception reports as opposed to conducting a part number by part number review of material release data. The data passes through a limited number of hands, and personnel do not manipulate release data if at all avoidable. These practices save time and ensure quality.

For these reasons, the majority of support provided to Douglas and Lomason was related to the preparation and validation of metrics data.

Key Issues and Lessons Learned:

- It is possible to create a culture that "trusts" a material release processing system that reduces human intervention to an absolute minimum.
- The key success factor to creating such a culture is identifying and eliminating the root causes of erroneous data to the extent that it is possible.

3.1.3 Lear Favesa

Tier: Two (Trim)
MAP Product: Seat Cover
Location: Seat cover plants in Juarez, Mexico
Warehouse distribution facility in Melvindale, MI

Lear Favesa Corporate Profile:

Lear Favesa is a wholly-owned subsidiary of Lear Corporation, a producer of seats and related products such as armrests, headrests, molded foam cushions, seat covers, and seat frames. Lear Favesa produces seat covers in three plants in Juarez, Mexico, has 6,500 employees and annual revenues of $450 million. Roughly 5% of Lear Favesa's business is derived from MAP products. Favesa was bought from Ford by Lear in November, 1993.

Lear Technical Capabilities:

While owned by Ford, Lear operated under Ford's CMMS system. After being purchased by Lear, Favesa was given two years to phase out and replace the Ford system. In July, 1995 Lear Favesa began implementation of the QAD manufacturing pro information system. In October, 1995 Lear Favesa gained EDI capability under the new system and began sending ASNs to JCI. Up until this time Lear had only had the ability to receive incoming EDI transaction sets from Ford.

Implementation Support Provided:

Because they were owned by Ford and part of the Ford CMMS system, Lear came into the MAP project with both technical and process-related EDI experience. This experience proved valuable once Lear changed systems and gained the ability to exchange EDI transaction sets with a larger number of customers and suppliers. For this reason, Lear relied heavily on their experience and resources to implement MAP recommendations. ITI and Wizdom worked with the Lear project manager to create an implementation plan. The plan was based upon initial analysis and interview findings.

An analysis of Lear's processes uncovered that an inordinate amount of time was being spent dealing with unreliable release data from a specific customer. The Wizdom team attempted to work with Lear and the customer to trace the problem upstream to its root causes and create a plan for improvement.

Implementation support focused on two main issues:

1. Determining root causes of unreliable material release data from a specific customer
2. Preparation and validation of metrics data

In addition to these projects, the majority of Lear's effort during the course of the MAP project revolved around the issue of transitioning from one information system to another.

A combination of internal and external process and technical changes led to significant reductions in material release processing time. The major changes that impacted lead time are as follows:

External process change:

- JCI lead time reduction from three days to one provides Lear with 830 material release two days earlier.

Lear technical change:

- Ability to receive EDI from JCI reduces need to manually validate and re-key data, saving several days of labor.
- Lear gains ability to do EDI on 90% of all incoming orders. Reduces total time required to process all manual releases.

Lear Process Change:

- MRP run moved to Tuesday, material releases sent out on Wednesday. This change, coupled with the earlier incoming releases from JCI, gives Lear enough time to send out releases within 1-2 days of receipt.

The following is a comparison of the original and new processes.

Original Process, March, 1995: Order processing cycle time = 1 week

characteristics of original order release process

- MRP runs on Monday and Thursday
- Release received from JCI on Wed
- Release manually reviewed and re-keyed
- Outgoing release sent out on following Tuesday.

New Process, March, 1996: Order processing cycle time = 2 days

characteristics of new order release process

- MRP runs on Tuesday
- Releases received via EDI from JCI on Monday (Tuesday latest)
- 90% of all orders are now EDI, fewer manual orders to re-key
- All outgoing releases sent out on Wednesday

Key Issues and Lessons Learned:

- External and internal changes impact lead time: When a supplier conducts MRP runs on fixed days, a small improvement in customer's order processing lead time can translate to up to a one week reduction in supplier lead time.

- Lear's ability to send timely, accurate information to its suppliers is largely dependent on the quality of information received from its customers.
- The quality of release information tends to vary by both customer and part number.
- A relatively small number of "problem parts" cause a majority of downstream problems, errors, re-work, and cost. Finding is consistent with the 80-20 rule.
- Lear experience highlights the trend within the automotive and other industries towards rapidly increasing use of EDI.
- Lear's reduction in the number of its suppliers, from 1,000 in March 1994 to 200 in April 1996 is representative of the general automotive industry trend towards supply base consolidation. As automotive companies consolidate their supply base, more and more is being expected from their suppliers.

3.1.4 Atwood Automotive

Tier: Two (Hardware)
MAP Product: Seat track
Location: Seat track manufacturing plant in Stockton, IL
Corporate headquarters in Rockford, IL

Atwood Automotive Corporate Profile:

Atwood-Stockton manufactures assembled automotive components, primarily manual seat slides, seat subframe assemblies, and door hinges. Most products are formed through stamping of roll steel stock, secondary forming and welding, coating and painting, and final assembly and packaging. Plant layout is generally by machine process with a mix of line and cell assembly. Employment ranges from 500 to 800 employees working 3 shifts, 5 days per week - plus a satellite assembly operation at Mt. Carol. The plant is one of several main sectors serviced by a central corporate staff for sales, IS, and administration. EDI transaction sets are received, processed, and run through the MRP at corporate headquarters in Rockford. Material Requirements are sent to the Stockton plant, where the information is utilized to order raw materials and schedule the shop floor.

At the outset of the MAP project, Atwood was receiving EDI 830 material releases from JCI. Atwood was sending material release data to its MAP suppliers by fax. The order processing cycle time was approximately one week and a half due to extensive manual interventions and inefficient supporting processes.

Atwood's centralized information system was custom-designed and built by Atwood MIS staff. The aging system limited the project team's freedom to reduce order processing cycle time to the desired degree.

Implementation Support Provided:

Representatives from ITI and Wizdom worked with the Atwood project manager to create the following implementation plans:

- EDI Implementation Plan
- E-Mail Implementation Plan

The plans were based upon the results of an initial analysis of the company's operations and interviews with key personnel.

In December of 1995, the AIAG project team received a commitment from the VP of Manufacturing to increase Atwood's involvement in the MAP project. Wizdom conducted a thorough review of company processes, management practices and financial/ performance data and that the greatest impact on improvements in the material and information flow could be achieved by conducting a full review of all Stockton plant operations. Agreement was reached between all parties concerned. In January 1996 this subproject titled "Systematic Practices Improvement" was initiated at the Stockton, Illinois plant.

Scope of Systematic Practices Improvement:

1. Support the supervisory / management team to pinpoint those work processes and management practices which matter most in order to process customer orders more effectively and to achieve other performance goals of the company. Describe these processes in terms of an "As-Is" process flow model with emphasis on information flow, material flow, measured management practices, and measured performance results data.
2. Aid the supervisory / management team develop a plan for improving these processes and practices. The plan emphasized the fully-integrated implementation of EDI (Electronic Data Interchange), manufacturing information systems improvement, and material flow. It also included performance improvement goals and economic justifications for planned actions. Supporting this were project plans, schedules, and individual responsibilities.
3. Assist the supervisory / management team build enthusiastic commitment for this plan to enable implementation.

Methodology

To achieve the objectives of the project, an advanced diagnostic procedure was assembled from several components and customized to achieve optimum performance.

- Observations of operations to gain understanding of the products, processes, procedures, management practices, operating problems, and other factors.
- Collection of performance data regarding such factors as sales, costs, productivity, quality, etc.
- Private interviews with each participating manager to gain additional understanding of operations, management practices, problems, etc.
- Use of the Performance / Practices Analyst (PPA) survey to gain additional insight regarding specific management practices.

Conclusions and Recommendations

1. Performance Results - Labor costs can be reduced during the current fiscal year by 5% of sales through a primary focus on productivity improvement in all key areas. Order processing cycle time could be reduced on the information side from one week to 2.5 days, and on the material flow side from side from, three weeks to one week. Inventory turn rate could be more than doubled.
2. Management Practices - Gains can be achieved through aggressive performance improvement goal responsibilities, a structure for project participation and planning, establishment of more effective performance tracking and problem identification techniques, establishment of follow-up accountability, communication procedures, and motivational consequences.
3. Work Processes - Business Process Re-Engineering: manual procedures associated with the computerized order processing and scheduling systems, more effective use of Kanban scheduling, improved press and setup methods, re-engineering of assembly operations, more effective application of cellular manufacturing concepts.

Key Issues and Lessons Learned:

- Atwood Automotive was purchased in April 1996 shortly after the creation of the process improvement plan. The implementation of the plan has been put on hold as the new owner conducts an assessment of all Atwood operations.
- Difficulty in obtaining commitment to MAP project and resistance to change:

  - These issues are described in the Automotive Industry Action Group's *Initial Evaluation Report*

- Integrated EDI is not enough -- a company must possess efficient processes and supporting processes. Atwood's EDI is fully integrated into its information systems. However, due to extensive manual interventions and additional factors order processing cycle time remains over one week.
- Existing information systems can limit potential success.
- The project team experienced difficulty in obtaining complete and reliable metrics data from Atwood's Stockton plant. The root cause of this difficulty is the lack of complete and accurate internal information.

3.1.5 Dudek and Bock

Tier: Three (Hardware)
MAP Product: Springs
Location: Chicago, IL

Dudek and Bock Corporate Profile:

Dudek and Bock produces wire form and spring products for a wide range of manufacturers primarily in the appliance and automotive businesses. Automotive industry represents slightly less than 20% of Dudek and Bock's total business. MAP project parts currently make up roughly 1% of total sales.

Most products are produced through primary forming of wire steel stock at either four-slide or spring forming machines. Thermal treatment is performed at each machine. Some secondary forming, stamping, and/or assembly occurs. Plant layout is generally by machine process with an effort to combine operations. There are 310 total employees, working one plus shifts, 5 days per week.

Implementation Support Provided:

Representatives from ITI and Wizdom worked with the Dudek and Bock project manager to create the following implementation plans:

- EDI Implementation Plan
- E-Mail Implementation Plan

The plans were based upon the results of an initial analysis of the company's operations and interviews with key personnel. During October 1995 the team held an executive review session to receive authorization from the executive vice-president and C.O.O. of Dudek and Bock to proceed with implementation efforts as detailed in the plans.

After working receiving 830 material releases from Atwood, the project team launched a review of Dudek and Bock business processes within the scope of the MAP project. This constituted a follow-on study to further integrate the lessons from the MAP project into the flow of material and information through the business cycle. In April 1996 a subproject titled Systematic Practices Improvement was initiated at the Chicago, Illinois plant.

Scope of Systematic Practices Improvement

As in other efforts the concept of using support from the supervisory / management team to pinpoint work processes and management practices which matter most was followed. However as the time frame for data collection was limited by constraints of business parameters the emphasis was focused on measured management practices and measured performance results data.

Methodology

To achieve the objectives of the project, an abbreviated form of the advanced diagnostic procedure was assembled from several components and customized to achieve optimum performance

- Observations of operations to gain understanding of the products, processes, procedures, management practices, operating problems, and other factors
- Collection of performance data regarding such factors as sales, costs, productivity, quality, etc.
- Private interviews with each participating manager to gain additional understanding of operations, management practices, problems, etc.
- Use of the Performance / Practices Analyst (PPA) survey to gain additional insight regarding specific management practices

Summary Conclusions and Recommendations

1. Performance Results - Labor costs can be reduced during the current fiscal year by 5% of sales through a primary focus on productivity improvement of at least 15%. Inventory turn rate could be more than doubled by redesigning the purchasing process to reduce raw material inventory and implementing a "pull" manufacturing system.
2. Cost Estimating - The cost estimation processes can be reengineered to decrease cycle time from almost one week to several hours.
3. Work Processes and Management Practices, although identified as having significant opportunity for improvement, were not detailed due to the limited nature of the investigative effort.

Key Issues and Lessons Learned:

- The integration of EDI into business systems at Dudek and Bock has been delayed to the summer of '96 at the earliest. The delay arose from the inability of Dudek and Book's software supplier to write integration software. As a result, Dudek and Bock has not been able to fully implement reengineered processes.

3.1.6 R-R Spring

Tier: Three (Hardware)
MAP Product: Springs
Location: Franklin Park, IL

R-R Spring Corporate Profile:

R-R Spring is a privately owned, 34 employee manufacturer of springs founded in 1970. Approximately 50% of R-R Spring's business is in the automotive industry. Atwood Automotive represents approximately 14% of R-R Spring's business. Sales in 1995 were over $4,000,000, a fifty percent increase over the previous year. This significant increase in volume resulted in the straining of existing processes, affecting productivity, on-time shipments, and profitability. The implementation and integration of EDI provided R-R Spring the opportunity to redesign the company's business processes to increase plant-wide productivity.

At the outset of the MAP project R-R Spring had no EDI capability.

Implementation Support Provided:

Representatives from ITI and Wizdom worked with the R-R Spring project manager to create the following implementation plans:

- EDI Implementation Plan
- E-Mail Implementation Plan
- EDI Integration Plan

The plans were based upon the results of an initial analysis of the company's operations and interviews with key personnel. During October 1995 the team held an executive review session to receive authorization from the president of R-R Spring to proceed with implementation efforts as detailed in the plans.

Significant process improvement support began at R-R Spring during February of 1996. A team formed of representatives from R-R Spring and Wizdom Systems conducted a combined assessment/planning project for the company. The assessment focused on the three key issues of performance, work processes, and management practices within the scope of the MAP project. In general, the team sought to determine the primary means for improving the information and material flow performance as they relate to each of the three preceding key factors. After a plan was developed, support then focused on the implementation of actions.

Assessment / Planning Methodology

Methodology for the Assessment/Planning project included the following activities:

- Private interviews with key managers to determine work process capabilities, management practices, performance problems, etc.
- Direct observations of operations to gain additional understanding of the same items
- Collection of performance data
- Application of a performance / practices survey
- Analyses of the information collected from the preceding activities with a view towards improving processes, practices, and performance results
- Development of recommended process and performance improvements
- Documentation of the preceding in a special report used as a working document to develop an improvement plan
- A management team workshop to develop an improvement plan

This methodology focused on specific details of the three key issues - performance results, work processes, and management practices. They included the following items.

- Performance results - sales growth, profits, costs, productivity, quality, customer service, process cycle time, inventory turns, etc.
- Work processes - Sales, order processing, EDI integration, forecasting and master scheduling, MRP, pricing, purchasing, inventory control, supply chain management, shop scheduling, manufacturing processes, plant layout, material flow, setup procedures, outside processes, storage systems, etc.
- Management practices - strategic planning, performance improvement objectives, project planning, communication, performance measurement, problem identification, problem and project follow-up, technical problem solving, time management, employee training, motivation, etc.

Planning Outcome

A special team work shop was conducted with the R-R Spring managers acting as the primary participants and the Wizdom consultants acting as facilitators. Significant opportunities for improvement and plans for achieving them were then developed for the following items:

- Performance results - aggressive goals for improving sales growth, profits, specific cost reductions, productivity, schedule attainment, order processing cycle time, and inventory turns were developed.
- Work processes - project plans to improve work processes were developed, and these included pricing, purchasing, master scheduling, inventory accuracy, inventory control, cellular technology, setup, and others.
- Management practices - project plans to improve management practices included those related to project planning, performance measurement and reporting, process improvement, problem identification, communication, employee training, and others.

These plans were documented and specified with regards to detailed project tasks, individual responsibilities, and schedules.

Implementation Actions

During the few months following plan development, the Wizdom team returned periodically to assess the status of R-R Spring's implementation activities and provide further assistance and guidance. These meetings were intended to assist the R-R Spring management in overcoming difficulties associated with plan implementation. The outcome to date of these efforts has included, but is not limited to, the following items:

- Significant gains in performance results particularly related to certain costs, schedule attainment, and inventory turns.
- Substantial improvements in work processes related to pricing, order processing and scheduling, purchasing, inventory control, and shop scheduling.
- Management practice improvements particularly related to performance measurement, problem identification.

Key Issues and Lessons Learned:

- R-R Spring's manufacturing operating systems are provided by a small, local, custom programmer. The system is currently underutilized because the supplier has not provided adequate training or documentation. Similarly, the supplier was slow to integrate EDI into internal business systems. The situation has become part of "business as usual," and a limiting factor in the degree of improvement attainable. Wizdom worked with R-R Spring to understand the priority and potential impact of increasing utilization of the system's functionality.
- Suppliers who utilized "off the shelf" systems instead of custom-built systems generally had an easier time integrating EDI into their business systems and leveraging the potential of their technology.
- R-R Spring achieved significant gains in lead time through process changes alone. During the spring of 1996, lead time was reduced from one week to one day by implementing a relatively simple process change.
- R-R Spring has relied in the past on largely informal processes which were sufficient for historic volumes, but have become taxed by sales increases. The R-R Spring experience underlines that small companies must address and solve process issues in order to grow beyond the historic limits of "manageable volume."

3.1.7 Specialty Screw

Tier: Three (Hardware)
MAP Product: Custom-engineered fasteners
Location: Rockford, IL

Specialty Screw Corporate Profile:

Specialty Screw produces custom-engineered fasteners and other cold-formed products. The company employs 100 people. Approximately sixty to seventy percent of Specialty Screw's business is in the automotive industry. The MAP project, i.e., sales to Atwood Automotive, represents 10-15% of all orders.

At the outset of the MAP project Specialty Screw was exchanging EDI transactions with Ford and had received a request from another customer to implement EDI. While several other customers had explored the possibility of implementing EDI with Specialty Screw, the volume of transactions was not sufficient to justify the cost. Specialty Screw's EDI was not integrated with its business applications, incoming 830 material releases were printed and then re-keyed into the manufacturing information system.

Implementation Support Provided:

Representatives from ITI and Wizdom worked with the Specialty Screw project manager to create the following implementation plans:

- EDI Implementation Plan
- E-Mail Implementation Plan
- Integration Implementation Plan

The plans were based upon the results of an initial analysis of the company's operations and interviews with key personnel. During October, 1995 the team held an executive review session to receive authorization from the president of Specialty Screw to proceed with implementation efforts as detailed in the plans.

Specialty Screw possesses a strong internal MIS department which programmed the integration software in-house. Wizdom consultants worked with the Specialty Screw team to document and understand their 'As Is' pre-integration processes. After integration, the new process required less manual interaction and significantly less employee time. The task of the Specialty Screw management team was to redefine the job responsibilities of the individuals who had previously spent a significant portion of their time on non-value added activities necessitated by the original process. Such activities included the manual checking of data on a part number by part number basis and the re-keying of release data. These employees now had time freed up to spend on value added activities such as client service and other functions that create value in the eyes of the customer. As is often the case, the integration of EDI into the company's business systems allowed Specialty Screw to redesign not only its processes but the job descriptions, responsibilities, and value of its workers.

Wizdom also worked with Specialty Screw in the preparation and collection of metrics data. Due to confidentiality reasons, Specialty Screw chose not to release dollar values of sales and inventory levels.

Key Issues and Lessons Learned:

- Executive level commitment is a key success factor. The presence of such commitment enabled the successful implementation of integrated EDI and redesigned business practices at Specialty Screw.
- Internal expertise and project management experience are additional success factors.
- A company's requirement for confidentiality can limit the efficacy of 'extended enterprise' analyses. In this case, full metrics data was not provided.

3.1.8 Rockford Spring

Tier: Three (Hardware)
MAP Product: Springs
Location: Rockford, IL

Rockford Spring Corporate Profile:

Rockford Spring is 200 employee producer of springs located in Rockford, IL. Like others, Rockford Spring is a third tier supplier in the context of the MAP project, i.e. for seat track parts, yet also a first and second tier supplier for several non-MAP parts.

Roughly 40% of Rockford Spring's business is automotive. The MAP project, i.e., sales to Atwood, represent approximately 40% of sales.

Implementation Support Provided:

The initial analysis conducted at Rockford Spring led to a reengineering of the order entry process. IDEF process models revealed that the lengthy cycle time for processing material release data could be attributed to an excessive number of hand-offs and delays in the process. The process was redesigned, changing the workflow of release data and reducing the number of people involved, and gaining savings in cycle time. These savings were gained through pure process changes, no new technologies were yet applied.

In order to effectively implement integrated EDI and e-mail, representatives from ITI and Wizdom worked with the Rockford Spring project manager to create the following implementation plans:

- Integration Implementation Plan
- E-Mail Implementation Plan

The plans were based upon the results of an initial analysis of the company's operations and interviews with key personnel. During October, 1995 the team held an executive review session to receive authorization from the president of Rockford Spring to proceed with implementation efforts as detailed in the plans.

Implementation assistance was provided to Rockford Spring as they planned for and executed the integration of EDI into their business applications. Wizdom representatives worked with the Rockford Spring project manager to identify a series of internal metrics that would accurately capture the savings in cost, time, and quality of integrating EDI and redesigning business practices. The tradeoff between the cost of investing time in collecting metrics data versus the value of the metrics was considered.

In addition, Wizdom representatives worked with the Rockford Spring project manager to document and understand the 'As-Is' processes and design new processes that would optimize returns from the implementation of integrated EDI.

The ITI staff assisted Rockford Spring in the transition to a new provider of EDI software that could be more easily integrated with the company's business systems. ITI also worked with Rockford Spring, Atwood, and JCI to assess the root cause of differences in cum calculation between trading partners. The cause was quickly identified through joint analysis and a solution was implemented.

Both ITI and Wizdom maintained regular contact with the Rockford Spring project manager to assist in project management issues.

Key Issues and Lessons Learned:

- Significant lead time reductions can be made through process changes alone.
- Close relationships between trading partners enable rapid problem solving.

3.1.9 Collins and Aikman

Tier: Three (Trim)
MAP Product: Fabric
Location: Roxboro, NC

Collins and Aikman Corporate Profile:

Collins and Aikman manufactures textiles for the automotive and home furnishings industries. The company is the largest supplier of interior trim products to the North American automotive industry. The company's divisions operate 43 manufacturing plants in the US, Mexico and Canada.

The Roxboro, NC plant produces piece dyed and yarn dyed fabric and operates as both a tier III and tier IV supplier to the automotive industry. As is typical of lower tier fabric suppliers, Collins and Aikman has long production lead times and supplier lead times. Total lead time is seven weeks: four of which is production lead time, three of which are supplier lead times. For this reason, the receipt of timely release information is of extreme significance to Collins and Aikman. The company spends substantial annual sums on premium freight due to late or inaccurate schedule information.

Implementation Support Provided:

The textile industry is highly competitive. In order to maintain confidentiality, Collins and Aikman chose not to accept extensive implementation assistance from the Automotive Industry Action Group, Wizdom, and ITI.

The project team provides assistance and support to Collins and Aikman primarily through the transfer of knowledge and lessons learned during analysis, planning, and implementation at other MAP companies. The team provided the Collins and Aikman project manager with full information regarding the benchmark 'best practices' model, tools for conducting variance analysis, common sources of error in order processing, and keys to a successful implementation of integrated EDI. In addition, Wizdom Systems worked with Collins and Aikman in the collection and validation of metrics data.

Collins and Aikman is currently using its own resources to compress the order processing cycle time. At present, this cycle time is approximately one week. The Collins and Aikman project team has created a plan which they have implemented that shrunk lead time down to approximately two days by the end of June 1996. It is estimated that Collins and Aikman will achieve one day lead time by the end of 1996. The team has identified its "black hole" and are working to close it.

Key Issues and Lessons Learned:

- A company's requirement for confidentiality can limit the efficacy of 'extended enterprise' analyses and supply chain-level process improvement.

3.1.10 Milliken and Company

Tier: Three (Trim)
MAP Product: Fabric
Location: Spartanburg, South Carolina

Milliken Corporate Profile:

Milliken and Company is one of the largest textile producers in the world. The company is privately held. The company was founded 124 years ago and employs over 14,000 workers. Annual sales are over $1 billion.

Implementation Support Provided:

Milliken has been highly concerned with maintaining confidentiality throughout the duration of the MAP project. In order to protect the confidentiality of its operations, Milliken chose not to accept implementation assistance from the Automotive Industry Action Group.

The MAP project team was able to facilitate the organization of meetings with Ford, Chrysler, GM and Milliken to examine the costs/benefits of creating special processes within Ford and GM to provide Milliken directly with planning data in Milliken part numbers. Chrysler had already been providing Milliken with such data. In the spring of 1996, Ford declined to take any action and GM was reconsidering it's position.

Key Issues and Lessons Learned:

- Milliken's project manager states that the majority of its gains have come from process changes, not the application of EDI technology alone.
- Milliken's desire to receive planning data *in its own part numbers* directly from the OEMs underscores the lack of faith lower tier suppliers have in planning data that arrives late and distorted. The MAP project recommendations seek to improve the system itself rather than creating a series of "work-arounds" to accommodate for an inefficient extended enterprise.
- A company's requirement for confidentiality can limit the efficacy of 'extended enterprise' analyses and supply chain-level process improvement.
- Milliken declined to submit metrics data in order to maintain the company's confidentiality.

3.1.11 Textileather

Tier: Three (Trim)
MAP Product: Leather

Implementation Support Provided:

Textileather ceased participation in the MAP project during the summer of 1995. No implementation support was provided to Textileather.

3.1.12 Conclusion

Given industry trends, including the recent OEM joint EDI requirements, more and more suppliers will have no choice but to implement EDI to remain competitive or to simply do business with certain customers. Empirical data suggests that most suppliers still implement EDI as a result of pressure from a major customer. The MAP experience clearly demonstrates the simple application of technology, in this case EDI, to a business system is not enough. Unless properly understood and implemented EDI, even when integrated into a company's MIS, can easily become a cost whose benefits do not justify its implementation.

The experience of the MAP project illustrates that there is a way to successfully implement EDI and reengineer business practices to leverage the benefits of the technology. The MAP experience offers a path that other companies can follow. Similarities in business structures of the pilot project companies allowed for a common approach to be applied across a variety of settings. This approach includes:

- Generic implementation plans for the implementation of EDI, e-mail, and integrated EDI that can be modified to account for the 'as-is' conditions of a given supplier.
- A proven Business Process Reengineering methodology.
- A benchmark best practices model and tools for performing a variance analysis
- Project management techniques.
- Change management strategies.

At a high level, there are four keys to successfully implementing EDI.

- Process expertise
- Technical expertise
- Project management expertise
- High level management commitment

ITI and Wizdom worked with participating MAP companies to supplement each company's existing level of expertise and resources. Implementation support provided assistance to insure that the best laid plans are translated into action. The majority of support went to smaller, lower tier companies who tend to lack process, technical, or project management expertise. The MAP project team committed resources to providing such assistance because it is recognized that 70% of the value of a product typically comes from the supply base. OEMs and first tier suppliers have a clear business interest in managing and improving the efficiencies of their supply base as they ultimately pay the costs of any inefficiencies through higher prices. The types of implementation support described in this report offer a methodology for conducting process improvement on the level of the extended-enterprise.

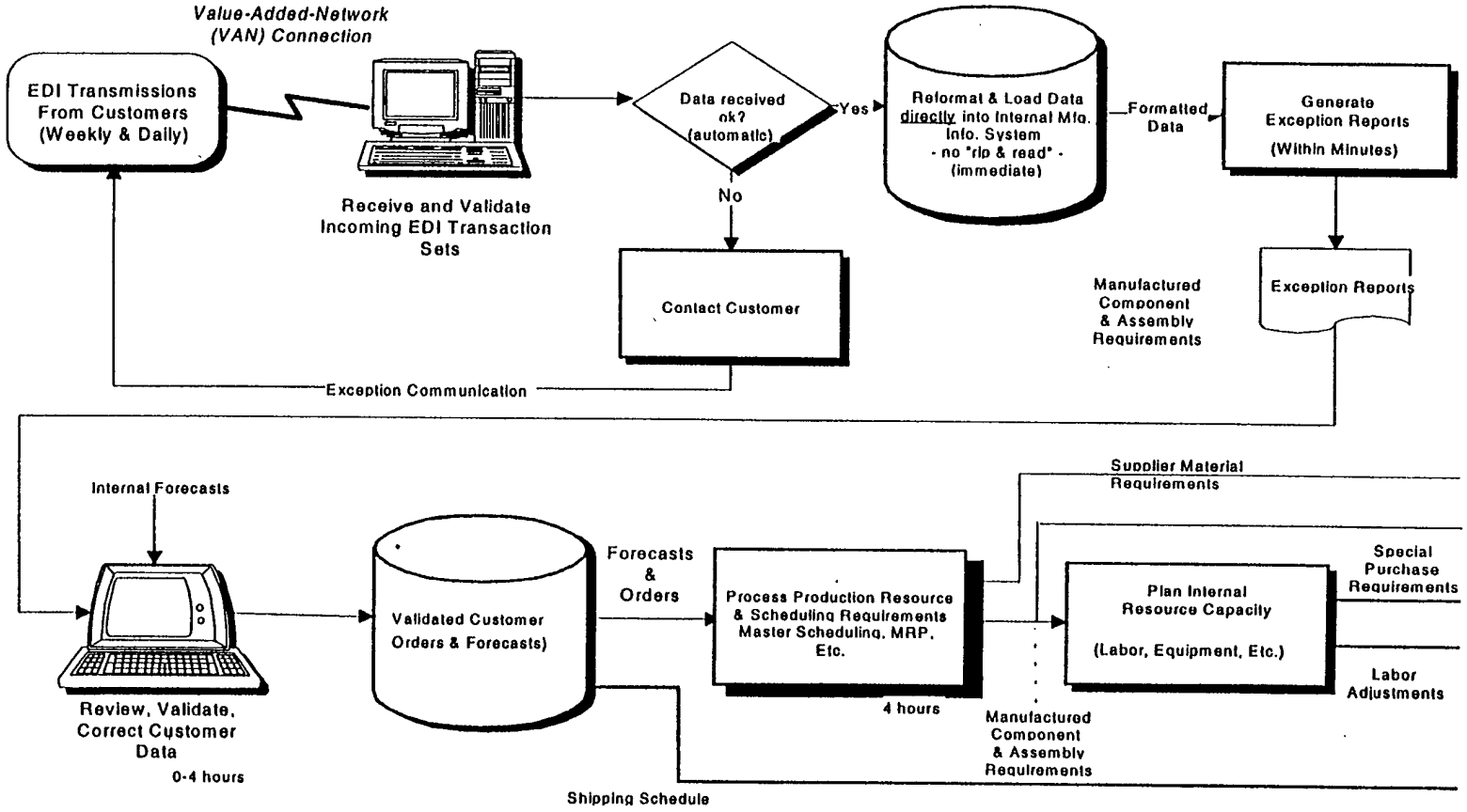

Figure 3-1. Benchmark Model of Electronic Data Interchange and Internal Business

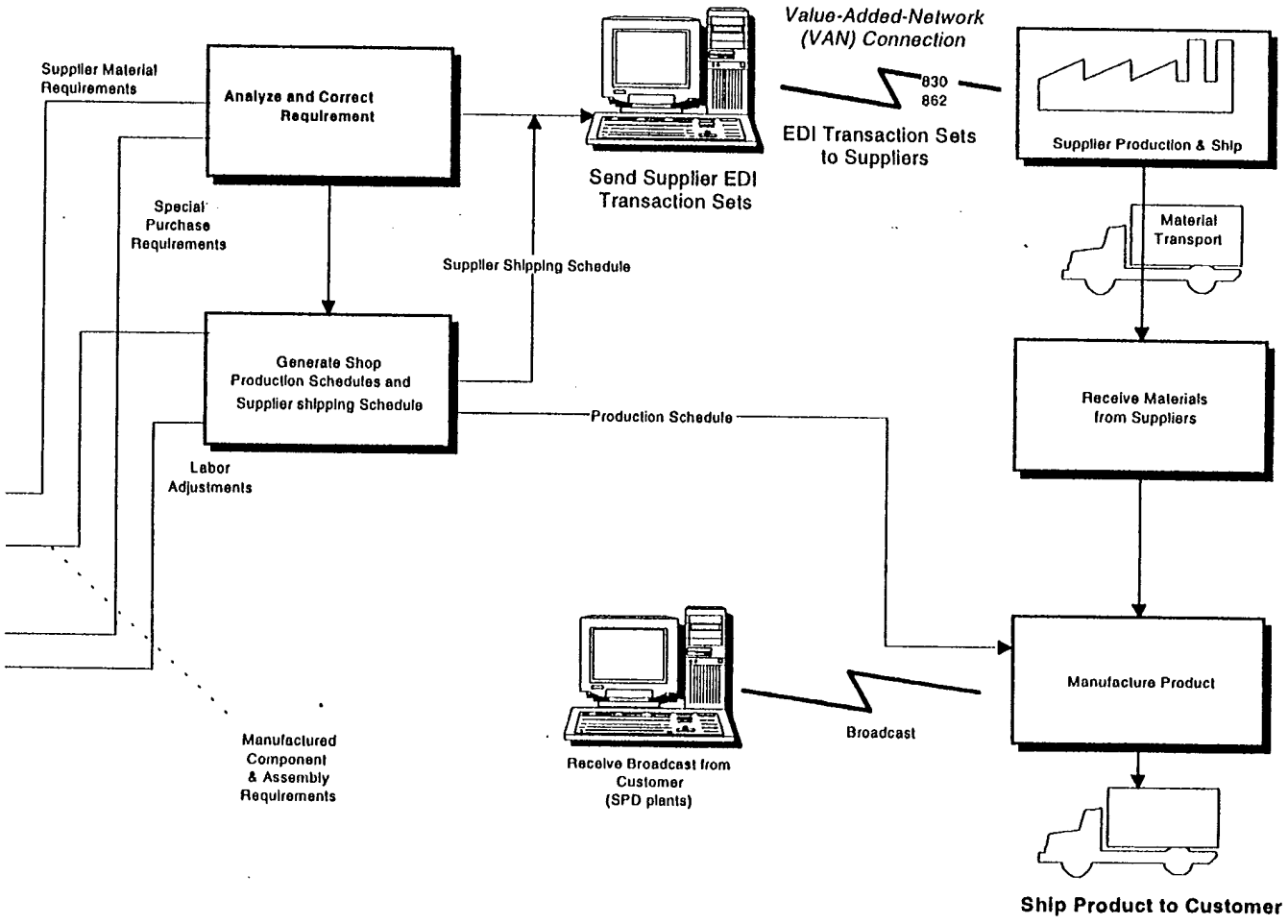

Figure 3-2. Benchmark Model of Electronic Data Interchange and Internal Business (p. 2)

3.2 Technical Implementation

3.2.1 Technical Implementation Scope

The MAP technical support during the implementation phase of the project was focused in supporting three of the Phase One Report recommendations for the lower tiers of the supply chain. These recommendations were:

- Recommendation 1. Two Way EDI throughout supply chain.
- Recommendation 2. E-mail for ancillary communications.
- Recommendation 8. Integration of EDI into internal business systems.

Since the OEM, Tier One and Tier Two Suppliers were compliant on Recommendations 1 and 8, there was little support required for these levels on the EDI issues. The Tier Three suppliers were the ones in need of the highest level of technical support. This was especially true within the hardware side of the supply chain. Two of the four hardware participants were Two-Way EDI capable but one decided during the EDI integration planning to change two-way EDI vendors to facilitate the integration effort.

As for Recommendation 2, the use of e-mail was uneven throughout the supply chain. While the OEM and Tier One participants had good physical e-mail environments, they did not have well established business practices utilizing the technology. At the Tier Two level of the supply chain, some firms had well established e-mail systems and others had no usable capability. The Tier Three firms also had a mixture of capabilities from full capability including external connectivity to no e-mail capability whatsoever. The lack of e-mail systems was the predominant scenario at this level.

An overview of the implementation efforts and the support provided to implement each of these three recommendations is detailed below. The overview is followed by detailed descriptions, by tier, of the implementation efforts that required the largest amount of support from the MAP technical team.

3.2.2 Two-Way EDI Technical Implementation

The Phase One Report called for the use of a minimum number of standard EDI transaction sets by all trading partners with their customers and suppliers. A group of first priority transaction sets was established. These were the ANS X.12 830 Materials Release, the ANS X.12 856 Advanced Ship Notification, and the ANS X.12 997 Functional Acknowledgment.

During the detail planning phase of the implementation it was decided to concentrate on the 830 Material Release. This decision was based on the participants input that this transaction set would have the greatest impact on improvement within the supply chain. The rationale was that a more accurate forecast received in a shorter time period would improve the overall performance of the supply chain to a greater degree than the other transaction sets. As a result, the MAP implementation team concentrated on implementing the 830 Material Release.

The requirement to implement the 997 Functional Acknowledgment was also modified from the position as stated in the Phase One report. It was strongly suggested that the Tier Three suppliers utilize the 997 until the trading partners were satisfied that the EDI systems were functioning correctly. At that time the use of the 997 was to be decided by each pair of trading partners. At the higher tiers, the use of the 997 was not sharply defined. Johnson Controls stated that they would receive 997s from suppliers but would not process them. At the OEM level, Ford and GM stated that they did not want to receive any 997 transaction sets. Chrysler said they would receive them but would not make their use a requirement.

Implementation schedule of the other high priority transaction set, the 856 Advanced Shipment Notification, was left to individual trading partners. The three OEM participants call for its implementation at the Tier One level by January 1997.

In addition to these first priority transaction sets, second and third priority transaction sets were defined. The second priority included the ANS X.12 824 Application Advice, the ANS X.12 862 Shipping Schedule and the ANS X.12 861 Receiving Advice sets. The third priority has as its only member, the ANS X.12 864

Text transaction set. While none of these were implemented during the pilot phase of the MAP project, the use of the 862 is called for by OEM and Tier One deployment plans down through Tier Three by mid 1999.

The major hurdle to implementing EDI throughout the supply chain was to address the issue as to the level of participation at Atwood Automotive. The technical implementation required Atwood to pass the 830 Material Release to the four Tier Three hardware suppliers.

This was a new capability being added to Atwood's trading partner configuration, so their participation was temporarily an issue. The Atwood management finally approved company effort to add the 830 Material Release to their outgoing EDI processing. Once the issue of Atwood participation was resolved, the implementation of Two-Way EDI went smoothly at all levels of the supply chain.

3.2.3 E-mail Technical Implementation

The final E-mail network had the greatest variance in the level of implementation of any of the recommendations from Phase One. Site e-mail systems varied from fully integrated desktop systems to single dial-up e-mail accounts on the Advantis Value Added Network. The major reason for this disparity was that the MAP team could not reach a consensus on how to use e-mail in the project. Many valid uses were discussed, including the use of e-mail to support other Phase One recommendations.

The main candidate discussed was Recommendation 3, Supplemental communication to lower tiers of large scale schedule changes. After many weeks of discussion, it was decided not use e-mail for this capability. The method to be used for communicating this change was left to each set of trading partners.

Several meetings were held to establish a strawman business case for the use of e-mail. None of the suggested uses were agreed upon and the project team divided itself into two camps. One camp felt that e-mail was an essential business tool while the second saw no real benefit in its use. As a result of this breach, no firm requirement for e-mail use was established.

The actual use of e-mail varied greatly within the individual firms. Johnson Controls, which had an integrated desktop e-mail system, decided to use it as an additional means of communication between itself and the primary contacts at the various OEM plants supported for the MAP project. While the three OEM companies did not object to this use, the cultural acceptance at their facilities varied greatly.

Some firms, such as Specialty Screw, were successful in implementing e-mail. Others could not implement integrated e-mail in a timely manner for heavy use during the pilot. As a result, a majority of the Tier Three firms elected to implement e-mail by obtaining a single e-mail account from a commercial provider. In all except one case the commercial provider selected was their EDI VAN service.

Figure 3-3 below provides a pictorial view of the e-mail network as developed for the MAP project.

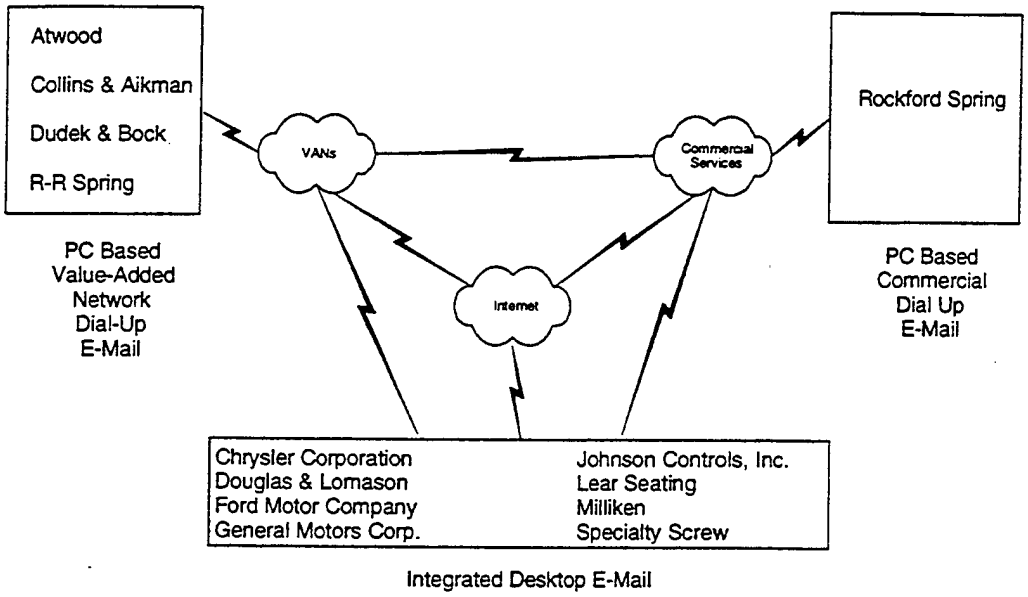

Figure 3-3. MAP E-mail Network

3.2.4 EDI Integration Technical Implementation

The goal of EDI integration as stated in Recommendation 8 of the Phase One Report was to apply EDI data received electronically directly into the appropriate application software. With the concentration on the 830 Material Release, the integration effort focused on apply the data to MRP and/or shop floor scheduling packages. The variety of systems among the participants lead to high level of engagement in planning and implementing the integration strategies at the various firms.

In all cases except one, EDI data was successfully integrated with the required applications. In that one case, the participating firm decided to wait for the release of their software vendor's EDI integration modules. The release date of August 1996 fell outside of the MAP project's time schedule. However, since this firm was at the end of the hardware side of the supply chain, the lack of integration had minimal impact on the performance of the overall chain.

One other firm did not complete its integration effort at the end of the metric collection period. This lateness was a result of their software vendor's delay in delivering the integration software. As in the case described above, this firm was also at the end of the hardware supply chain and therefore had little impact on the movement of data throughout the MAP chain. This firms results of introducing Two-Way EDI were so outstanding that their initial anecdotal input was that the integration resulted in a considerable level of improvement.

The effort expended in providing technical support for the integration task was the single largest task performed. However, the integration task was the key factor in driving down the lead times throughout the supply chain. This was especially true in the hardware portion of the MAP supply chain.

3.2.5 Participating Firms Technical Implementations

The technical planning and implementation process consisted of four basic steps. These were:

1. Develop detailed plans for all three recommendations.
2. Evaluate plans for alternatives and make final selections.
3. Obtain management approval for plans.
4. Implement plans.

This activity was performed by a team comprised of one or two members from the participating firm and one to three persons from the technical and business process MAP support team. Other members of the participating companies' staffs were involved as their areas were impacted by the planning and/or implementation efforts. In addition, support staff from various vendors were used as required for particular installations.

The plans were considered living documents during the planning and implementation activities. This was due to two main factors. First, many of the firms identified multiple scenarios that could meet the requirements of the recommendations. As a result of this fact, the planning process included evaluation of these different scenarios as distinct tasks within the plans. Second, as the various business processes were defined during the planning and implementation, unforeseen changes often arose that required a modification to the plans. By maintaining the plan as a living document, changes could be incorporated to accurately reflect the actions needed to complete the plan.

A detailed description of each of the four steps follows. Example plans are contained in the appendices.

1. Develop Detail Plans for All Three Recommendations:

Step one was to develop the plans for implementing all three recommendations. The rationale for doing all three plans before any implementation was the high degree of interdependency between the technologies. The relationship between implementing Two-Way EDI and Integrated EDI is obvious. It is impossible to consider one of these two activities without looking at the impact of the other. The e-mail relationship may not be as apparent. The main connecting point between the EDI and E-mail effort was the physical communication means. Since almost all of the VANs also provide some level of e-mail service, the alternative of using these services was considered in all cases where e-mail was being introduced for the first time. This meant that the e-mail planning process had to take into consideration the VAN selection contained within the EDI planning.

As the various technical scenarios were developed the impacted business processes were identified. Next the definition of new processes, or modifications to existing processes, were developed and implementation planned. Business processes were included in the plans because it is impossible to properly implement these technologies without developing the supporting practices and procedures.

2. Evaluate Plans for Alternatives and Make Final Selections.

The next step was to evaluate the alternate technical solutions identified during the initial planning process. While it may appear that this is just a normal part of developing a detail plan, this was used as a distinct activity due to the fact that many of the firms were not used to detailed planning. This was particularly true of the smaller firms. Often they would ask the MAP implementation support team to tell them what they needed to buy to meet the requirements for various recommendations. By developing plans with multiple scenarios and then evaluating these possible solutions, the participating firms gained a higher level of knowledge concerning the technologies and the business practices required to support their individual businesses.

Often the evaluation of alternative solutions was an issue of financial investment. In several cases, possible implementations that provided a more robust technical solution were not selected because the cost was deemed too high.

3. Obtain Management Approval for Plans.

After the final implementation selections were decided and the plans finalized to reflect these decisions, a formal review of the plan was held with the management to obtain approval to proceed. In all cases except

one, management had been updated regularly by their staff during the planning process. In the cases where management had been updated, the meeting took one of two forms.

The first, and most common, form was to give upper management a briefing to describe any final decisions that had been made at the end of the planning process. The second case involved using the final management briefing to inform all of the management team of the final plan and to get any last input from them on the plan's details. Both of these scenarios worked well and the majority of the plans were approved as presented.

The one case where the plan was not approved as developed was in the case where upper management had not been briefed regularly during the planning process. In this case, upper management raised some concern about the staffing levels required to accomplish the tasks in the plan. As a result, the plan was revised extensively. The resulting plan delayed several major tasks, including EDI Integration, until well after the end of the pilot phase of the project. This did not have a major impact on the project since this firm was at the end of the supply chain and did not have to pass any transactions to subsequent levels.

4. Implement Plans.

The final step was to implement the plans as approved. Implementation was performed by internal staff within the firm, the technical implementation team and in some cases by members of the vendors support organization. Both technical and business process implementation was performed. The most difficult piece of the implementation process often involved third party software vendors meeting development schedules. This was particularly true in the area of EDI integration. One vendor was just developing their integration software and significantly underestimated the level of effort required to meet the requirements. But in general, plans were executed on schedule with good technical and business process implementations.

3.2.6 First Tier Implementations

Very little technical assistance was required at this level. Johnson Controls has been a leader in EDI implementation as well as Just-In-Time scheduling and delivery processes with both OEMs and many of their suppliers. The use of e-mail was not prevalent at this level between the various trading partners. The establishment of business uses for e-mail was the major activity at this level.

3.2.7 Johnson Controls, Incorporated

Two-Way EDI Implementation:

JCI required no assistance in this area. With the concentration on the 830 Materials Release transaction set, they were compliant with the MAP requirements at all of the locations involved in the pilot. Johnson Controls technical staff were very helpful in establishing the template for the 830 transaction set. In fact, the JCI 830 template was used as the standard format through the entire hardware chain and most of the trim supply chain.

E-mail Implementation:

JCI has an integrated desktop e-mail system with external connectivity. Staff members are formally trained in the use of the system. This has resulted in a wide use internally at JCI. However, business uses for external communication were not formalized. The major technical activity established external e-mail addresses for JCI MAP participants--their main contacts at the OEM manufacturing facilities and key supplier contacts. Initial testing was performed with the MAP Testbed to confirm the reliability of external connectivity.

EDI Integration Implementation:

Johnson Controls EDI was fully integrated with their application systems. They have an active program to incorporate all the recommended transaction sets from the Phase One Report within the next 12 to 18

months. The major addition will be the use of the 824 Application Advice for their planned introduction of Evaluated Receipts schedule for the first half of 1997.

3.2.8 Second Tier Implementations

Technical assistance at the Tier Two level was concentrated in aiding Atwood Automotive implement e-mail and EDI with their Tier Three suppliers. Douglas and Lomason (DandL) and Lear did not require any significant levels of technical assistance. DandL had an excellent e-mail system with solid external connectivity. Their EDI systems were well established and adequately integrated with internal business systems.

Lear Seating was involved in a hardware and software systems change moving from the Ford systems to their own HP9000 based QAD implementation. Hardware and software problems delayed their EDI implementation and no internal cycles were spent by their systems support staff to provide e-mail services for the MAP effort.

3.2.9 Atwood Automotive

Two-Way EDI Implementation:

The two main activities at Atwood for Two-Way EDI are the incorporation of the Johnson Controls 830 Material Release data elements into the current 830 template and the addition of the four tier three hardware suppliers as EDI trading partners.

Atwood was unable to obtain an 830 Materials Release template from their EDI vendor. After careful comparison of the current 830 template and the Johnson Controls' 830, it was decided that the differences were very minor. This comparison was necessary since all four hardware suppliers would be using the Johnson Controls overlay from Supply Tech. Atwood made the commitment to incorporate the one minor change into their system during integration. A test of the compatibility between the two 830 formats was done utilizing the ITI Testbed. This testing proved that the Atwood could transmit using their current 830 format and that the four hardware trading partners could receive the transaction using the Johnson Controls 830 format from Supply Tech.

The addition of the four new trading partners was a routine procedure accomplished during the testing of transmission of the 830 Material Release. The mail boxes were added to the communications on Atwood's VAN using the individual firm's Dun and Bradstreet number. A few routine problems were encountered but none were of any significance. All four trading partners were added, the 830 tested and production delivery started within eight weeks of the beginning of this task.

E-mail Implementation:

Atwood supported e-mail internally on a Novell network. This network did not have an external connection. Discussions were held on upgrading their e-mail system to provide the capability to communicate with non-Atwood sites. This had been scheduled for mid 1997 as part of the Atwood MIS environment improvement. After review of resources it was decided by the Atwood management to plan for a 1997 implementation.

As an alternative, it was agreed to install a single IBM Mail account on a personal computer and use the current Advantis VAN connection to satisfy the MAP e-mail requirements. This scenario was successfully implemented and used throughout the project.

EDI Integration Implementation:

Atwood's EDI was integrated with their application systems prior to the MAP project. The major effort for EDI integration was to make the modifications necessary to generate the 830 Material Release transaction set for transmission to the tier three hardware suppliers participating in the pilot. This effort was accomplished within two weeks from start of the activity.

Once testing was started, a difference in the cumulative quantities shipped contained in the 830 was identified at Rockford Spring. With the assistance of Johnson Controls and ITI the discrepancy was diagnosed and Atwood made the appropriate corrections within one day.

3.2.10 Third Tier Implementations

The Tier Three firms require the highest level of technical assistance. Of the six active tier three participants during the implementation phase, four required a substantial amount of assistance. Two, Collins and Aikman and Milliken Automotive needed very little technical help. Both of these firms were EDI capable and had integrated EDI into a majority of their applications. Milliken had a good e-mail implementation with solid external connectivity. Collins and Aikman did not have an e-mail system. They did have four individual IBM mail accounts for executives that dealt with the automotive sector. Planning was started at Collins and Aikman for an e-mail system but this activity was not scheduled as part of the MAP project.

3.2.11 Dudek and Bock Spring

Two-Way EDI Implementation:

Dudek and Bock possessed Two-Way EDI capability prior to the MAP project. They utilized EDI with a large number of their customers. The existing EDI environment utilized the Supply Tech STX EDI translation software. Two tasks were needed to meet the MAP requirements in this area. The first task was to obtain and install the STX overlay for the Johnson Controls 830 Material Release. The second was to establish Atwood as an EDI Trading Partner. Both requirements were accomplished in a timely manner.

E-mail Implementation:

Dudek and Bock had a very limited e-mail capability prior to the MAP project. The engineering group used the native e-mail available on the internal Novell network. This capability was not available to everyone within the company and had no external access.

An evaluation was done as to the effort and cost to upgrade the Novell network to provide e-mail via Microsoft Mail. While the cost was not considered prohibitive, the implementation timing was poor in that Dudek and Bock was in the process of a complete hardware and software change. While e-mail capability had been one of the desired new capabilities, it was considered ancillary to the main thrust of the computing environment change. As a result, e-mail implementation was not scheduled until the second half of 1996 at the earliest.

To meet the MAP project requirements for e-mail, Dudek and Bock decided to obtain an IBM Mail account on Advantis. The Expedite Manager for Windows was installed on the EDI personal computer as the e-mail user interface.

EDI Integration Implementation:

Dudek and Bock was in the middle of a computing environment change. Most of their internal resources were being expended on this hardware and software conversion. Their supplier of manufacturing software announced an EDI integration module release for the spring of 1996. The MAP project team provided support to Dudek and Bock in evaluating the vendor's proposed capability. This included a trip to the vendor's home office in Minneapolis. After evaluating the alternative of developing flat file input, it was decided by their MIS management to wait for the vendor's EDI integration module.

As a result, no EDI integration was accomplished during the pilot. Since Dudek and Bock was at the end of the supply chain, the lack of this capability had no impact on moving the data from the 830 through the supply chain.

3.2.12 Rockford Spring

Rockford Spring put forth considerable effort to comply with the MAP recommendations. Some of the implementation was impacted by the fact that Rockford Spring moved to their new plant location during December of 1994. In addition to the move, Rockford Spring was in the midst of a major computer upgrade to meet the demands of their growing business. These two factors limited the amount of capital available for investing in the new technologies. Upgrading the computer environment did provide a more powerful system to implement some of the recommendations, in particular the EDI integration activity.

Two-Way EDI Implementation:

Rockford Spring had a successful Two-Way EDI implementation prior to the MAP project. They utilized the Harbinger for both EDI translation software and VAN services. They had 9 trading partners and were exchanging multiple EDI documents. The initial plan for adding the 830 Material Release from Atwood was to have Harbinger develop the required overlay and implement it using the existing 286 personal computer-based EDI translation software. However, during the planning for the EDI Integration, it was decided to convert the EDI environment to Supply Tech's STX EDI translation software to take advantage of the integration capability of the manufacturing software provider.

As a result of this decision, a new personal computer was acquired. The STX translation software was installed on this system. Additional software from Supply Tech was required to complete the integration of the EDI with the manufacturing software. STX templates were obtained for all of Rockford's trading partners and the associated transaction sets.

Extensive support was provided by the MAP technical support team for this effort. This support involved detail planning, evaluation of alternative approaches, management briefings, contact with vendors and actual support during the installation and conversion of the Rockford EDI environment. This support required numerous trips to Rockford Spring as well as telephone support. This was the largest single effort for the technical support team.

E-mail Implementation:

Rockford Spring had an internal centralized DEC All- In-One e-mail system that was gaining acceptance within the organization. There was a program to use e-mail to located misplaced tooling and stock. This program was very popular with the employees and was resulting in a large number of people using the e-mail system. However, with the move to the new plant location, use of e-mail diminished greatly. The program to locate missing items was dropped due to better organization at the new plant and from a lack of time of the staff promoting the project. External e-mail connectivity was not provided by internal system. The VAN being used a t Rockford did permit text e-mail messages but these were received on the single PC where the EDI transactions were received. This VAN e-mail system did not have an interconnect to the Internet. In addition, Rockford Spring installed a new voice mail system in conjunction with the move to the new building. It was felt by management that this would resolve most of the internal and external communication problems.

During the e-mail planning process many scenarios were evaluated at Rockford Spring. The scenario to add an integrated external capability to the internal e-mail system proved to be very costly. Management would not consider this scenario. In fact all scenarios except the very simplest were deemed unnecessary. The management position was that e-mail offered no real value and that the new voice mail system eliminated the need for e-mail. As a result, a single external e-mail account, using a dial-up connection on a PC, was established with a commercial provider to meet the MAP requirements.

EDI Integration Implementation:

The MAP technical support team spent a considerable amount of time planning this task at Rockford Spring. This was due to the uncertainty on the manufacturing software provider of how to proceed with the integration implementation. The vendor had an integration strategy that utilized the STX EDI translation software's flat file generation capability. However, there was no standard integration module for the 830 Material Release transaction set. As a result, special coding had to be done to incorporate the release data

into the manufacturing system. Considerable time was lost while waiting for the vendor to supply cost and time estimates for this activity.

In addition, the integration capability required the installation of a newer version of the base manufacturing software. In turn, this installation required the upgrade to a newer version of operating system on the Rockford Spring central computer. All of these factors were further complicated by the fact that performance estimates, based on the additional processing functions and increased number of users, indicated that additional memory and disk space would be required. The need to address all of these requirements lead to additional delays with the integration task.

Once the integration effort was started, the effort was accomplished with minimal delays and problems. The results of the EDI integration were very successful. As a result of the delays, the actual integration of the EDI data into the Rockford systems did not take place until three months before the end of the metric data collection. While this did not provide sufficient time to verify improvements due to integration, the Rockford Spring staff utilizing the integrated systems are extremely enthusiastic about the improvements and feel the expenditures of time and money to accomplish this task were very worthwhile.

3.2.13 R-R Spring

Two-Way EDI Implementation:

R-R Spring had no EDI capability prior to the MAP project. They had received requests to implement electronic trading from two firms outside of the MAP team but neither of these requests had a date for implementation. These two firms were notified that R-R was implementing EDI and updated by R-R personnel as the effort proceeded.

R-R had a personal computer network consisting of one server and five client machines. The planning activity involved extensive support from the MAP Technical Support Team. Numerous meetings were held at R-R to gather technical information and review alternative EDI solutions. The planning for EDI was to establish an EDI platform using the existing systems. However, during the EDI planning process, R-R decided to upgrade their server to a system with more memory and larger disk storage. The hardware was obtained and installed prior to the EDI software installation.

The EDI environment selected was the Supply Tech STX EDI translation software using Advantis as the Valued Added Network. The software was installed with assistance from the MAP Technical support team. During initial testing it was discovered that one of the two non-MAP firms had placed an 830 Release document in the R-R Advantis mailbox. This 830 was received successfully and processed manually by R-R. This allowed R-R to begin production processing of the 830 three months prior to receiving documents from the MAP trading partner, Atwood Automotive.

Prior to testing for the MAP 830, the Supply Tech 830 overlay for Johnson Controls was added to the STX environment at R-R. MAP EDI testing was performed with Atwood and production use of the 830 began in the fourth quarter of 1995. The only trouble encounter during this part of the EDI implementation was a minor problem in coordinating VAN mailbox ids with Atwood. Since this time, R-R has added additional EDI trading partners and additional transaction sets.

E-mail Implementation:

The e-mail planning exercise was very extensive at R-R Spring. R-R was very interested in having an desktop integrated e-mail system. They had done some experimenting with the e-mail system provided with their LANtastic network software but were never able to get it to work properly. Just prior to the e-mail planning, R-R had decided to upgrade the network software. As a result of these activities, the e-mail planning revolved around the idea of upgrading network software and implementing the LANtastic external mail server. Due to software system requirements, this plan required memory and disk upgrades to the personal computers used on the desktop. These hardware requirements raised the cost of the integrated e-mail system above the level of funding that R-R management was willing to commit to the project.

The less expensive e-mail scenario adopted by R-R was to utilize the IBM Mail services provided in conjunction with their Advantis VAN connection. R-R staff installed the Expedite for Windows e-mail user

interface software on a personal computer with a modem for the dial-up connectivity. Testing was successfully completed using the MAP Testbed located at ITI.

EDI Integration Implementation:

R-R Spring used an integrated manufacturing system that included order entry, scheduling, and inventory modules as their main business software environment. This software was provided by a small software development firm in the greater Chicago area. The system did not have any EDI integration capability.

The planning for EDI integration centered on using flat files to be generated by the STX EDI translation software as the input from the 830 Material Release into the manufacturing software. The software vendor would use the layouts of this data to generate the EDI interface software modules. Meetings were held with the vendor to establish development and delivery schedules. After agreement was reached on the schedule, development and implementation was approved.

During the development of the EDI interface software it became apparent that the developer had underestimated the effort to integrate EDI into the manufacturing software.

The delivery of the software was six months late. This caused the actual implementation of EDI integration at R-R to fall outside of the MAP metric data collection period.

3.2.14 Specialty Screw

Two-Way EDI Implementation:

At the beginning of the MAP project, Specialty Screw did exchange business data with one trading partner via a direct link to that customer's computing environment. They had received other requests to implement EDI but none had requested firm start dates. The computing environment at Specialty was a mixture of UNIX based systems with a Novell based network of personal computers.

During the planning for the two-way EDI implementation, several alternatives were discussed. Both UNIX and PC based EDI systems were discussed. Early in the planning process it was decided that a PC based system would be the most flexible and economical for their environment. It was decided to use the Supply Tech STX software. The major deciding factors were the cost and the ease with which the EDI integration could be accomplished.

The VAN selection activity was very straight forward at Specialty Screw. Since there was no large EDI partner bias in VAN usage, the major consideration was cost. After comparing pricing from the major VANs, GEIS was selected as the vendor of choice.

The only difficulty encountered during installation was in assigning the address to the EDI mailbox on the GEIS VAN. A conflict in addressing arose when transactions had to be passed to the Atwood mailbox on Advantis. The original plan had been to use the Specialty DUNS number as the mailbox id on GEIS. However, transactions could not done successfully transmitted between the two VANs when the using this number for the mailbox. As a result, the Specialty Screw phone number had to be used to as the mailbox id on the GEIS VAN. Once this change was made transactions were exchanged successfully.

E-mail Implementation:

Prior to the MAP project Specialty Screw had limited e-mail capability using the UNIX mail command. This system was used for short text messages between staff members. It was not considered an adequate system since it did not have a text editor, lacked a spell checker, and did not have an address book feature. The only external e-mail connection was through a CompuServe account within the MIS department.

Several options were explored during the planning activity to expand the e-mail capability. One option that was explored in depth was the use of GroupWise. Specialty Screw had a Novell network for connecting their personal computers. While technically feasible, the cost for this environment was greater than management was willing to fund. The major inhibiting item was the need to have a separate personal computer running IBM's OS/2 operating system to act as the e-mail gateway. The cost of this item plus the

GroupWise licenses made the cost of this alternative in excess of $13,000. As a result a more affordable alternative was selected.

The final e-mail environment selected at Specialty Screw was one based on the PINE system from the University of Washington. This is a UNIX based e-mail system that provides interfaces for both personal computers and the terminals running off the server. The system has the PICO text editor plus features such as spell checking and address books. PINE also has the capability to attach files from other applications such as word processors and spreadsheets.

External connectivity was established using the Internet. A dial-up account was established with a local Internet Service Provider. Connection was made to send and receive external e-mail four times a day. To this date this timing has proven satisfactory for receiving and sending e-mail.

Specialty Screw took the additional step of registering a domain name for the Internet. The name registered is *specialtyscrew.com*. This allows the Internet Service Provider to receive mail addressed to any user at Specialty via the domain name. All such mail is sent to the mail server when a connection is made and then stored in each users e-mail account at Specialty. In addition, registering with a domain name will permit Specialty to develop a World Wide Web homepage when they are ready to begin using the Web to distribute product information and generate sales leads.

EDI Integration Implementation:

EDI integration with the in-house business systems at Specialty Screw involved developing an EDI interface using flat files from the STX EDI translation software. The use of flat file output from the EDI transactions for integration lead to the selection of the Supply Tech STX EDI translation software. The flat files generated using the standard output option were used as input into the business applications. The Specialty Screw MIS staff developed these interface modules and successfully integrated the 830 Material Release data into their systems.

3.3 Metrics

3.3.1 Method for Selecting Metrics

Once the nine recommendations for the MAP project were established, the next step was to determine what metrics would be collected to measure the impact the recommendations had on the business operations of the participating companies. Based primarily on conversations with MAP project company personnel, an original list of four basic metrics was derived by the project team. Upon further review, this original list was deemed to be insufficient to fully support the potential success of the pilot project.

Due to the apparent lack of rigor and depth of the original four metrics, a subcommittee of the project team was put together to revise the metrics list. Working through June and July of 1995, the subcommittee generated a new list of six metrics. The list included the following: dollars spent on premium freight, on-time shipments, inventory turnover performance, obsolete material inventory dollars, number and cost of unplanned changeovers, and information flow lead time. Upon the submission of the revised list of six metrics, the list was approved by the full MAP project workgroup.

3.3.2 Metric 1: Dollars Spent on Premium Freight

Definition:

Identify all dollars spent to move freight by other than normal mode of transportation for all parts included in the scope of the MAP project.

- The premium costs must be paid for by your organization.
- The premium must only be for parts included in the pilot.

Method:

Premium freight dollars should be categorized in one of three categories as follows:

A) Premium freight caused by unplanned schedule increases.

B) Premium freight caused by late schedule information. "Late" is defined as more than 24 hours beyond the time you would normally expect to receive the schedule information.

C) All other premium freight for parts within the scope of MAP

D) Total premium freight for parts within the scope of MAP

These three categories (A,B,C) must add up to 100% (D) of the premium expended by each company in the previous month for those parts included in the MAP project.

Recommendations supported:

1, 2, 3, 5, 8, 9

Issues encountered:

- Gathering premium freight dollars data is relatively easy for all MAP partners.
- Certain companies experience difficulty breaking dollars spent into categories A, B, and C.
- Generally, it is extremely difficult to break historical data into categories A, B, and C.

Resolution of issues:

- Aggregate historical data on premium freight spending for MAP part numbers will be accepted if not possible to break into categories A, B, and C.

Expected findings:

- Spending on premium freight should drop as project recommendations are implemented.

3.3.3 Metric 2: On-time Shipments (by part number)

Definition:

The percentage of product shipments completed and shipped in accordance with the originally agreed upon ship date for all parts included in the scope of the MAP project. A supplier's shipments will be on-time when the total scheduled quantity for give part number is shipped on the agreed upon ship date; late shipments and early shipments (except those early shipments due to a customer request or due to standard pack quantities) are not considered on-time. The ship date for a part is defined by the customer schedule authorizing shipment or by the agreed to conversion of a delivery date/time.

Method:

$$\% \text{ On-time shipments} = \frac{\text{Number of on-time part number shipments}}{\text{Total scheduled part number shipments}} \times 100$$

The Number of On-Time Part Number Shipments is the Total Scheduled Part Number Shipments minus any late or early shipments for all parts included in the scope of the MAP project. If a customer provides both a date and time for shipment, the time must be considered in the early/late determination. (An easier way to determine may be keeping track of the late, early and total part number shipments.)

Timing:

The percentage of on-time shipments with the numbers leading to the percentage should be reported monthly. Data should be collected weekly to coincide with typical scheduling frequency as well as to highlight corrective actions to specific problems quickly.

Recommendations supported:

1, 3, 5, 7, 8 ,9

Issues encountered:

- Different companies recognizing different dates:

  Companies can ship to an 830, 862, a broadcast, or a "pull" communicated by FAX or telephone depending upon their information systems and internal business processes. In the initial conversations with MAP partners, the team found that different companies recognized different dates as the "originally agreed upon ship date." Companies recognized the date from either a) the 830, b) the 862, c) a broadcast, or d) phone/FAX "pull" date. Because of discrepancies between the 830 date and the date of the 862, broadcast or phone/FAX "pull" the same company can appear to ship 100% on time or 20% on time depending upon which date the metric utilizes.

- Differences between 830 and 862 (or appropriate shipping schedule) cause problems for suppliers.

Resolution of issues:

- Date of most recent electronic transmission:

  All companies will use the date of the most recent electronic transmission (830, 862, or broadcast) as the "on time date" for purposes of calculating On Time Shipments. For upper tier suppliers this date will be either the 862 date or broadcast date. For lower tier suppliers who do not ship to an 862 or broadcast, this date will be the 830 date.

- Differences between 830 and 862 (or appropriate shipping schedule) will be reported as an additional metric.

Expected findings:

- The percent of on time shipments should increase as the MAP project recommendations are implemented.

In addition, we attempt to quantify the result of the difference between the 830 and 862 as well as the variation in this difference upon the other metrics. For example, a supplier who does not receive accurate 830s may undertake a strategy of maintaining buffer stocks of inventory to hedge risk. Such a relationship, if significant, should be reflected in the metrics.

3.3.4 Metric 3: Inventory Turnover Performance

Definition:

Inventory turnover is a key indicator of the efficiency of a material flow system. It can be affected by delivery constraints imposed by suppliers (lead time) and by the rate of sales for a given period of time. Within the scope of this project we consider three month inventory turns. This reduces system noise and enables us to determine what trend is developing based on implementation of our nine key recommendations.

Method:

To calculate three month inventory turns, monthly information on sales dollars and total inventory level is required. We only collected data and calculated turns for parts associated with the MAP project.

Total sales is the summation of sales for each end item part number for the month (only MAP parts should be considered). Sales dollars for each end item can be calculated by multiplying the total number of parts shipped for the month (MAP parts only) by the selling price.

Total material inventory includes all parts, finished in-process and raw, that contribute to the production of the MAP project parts.

Recommendations supported:

All

Issues encountered:

- How should the value of assemblies that contain non-MAP products be counted? The majority of components in a seat assembled at Johnson Controls are non-MAP components. If valued at full value, inventory turns will be overstated.
- Should MAP parts that were not shipped during the current month be included in inventory levels?
- How can the value of raw materials that are used in both MAP and non-MAP products be quantified?

Resolution of issues:

- Products that contain non-MAP components should be valued according to the value of MAP components. Johnson Controls calculated the standard cost of MAP components in a seat assembly and multiply this number by monthly sales volumes. In this case, Johnson Controls valued inventory at COGS while other companies made use of sales value. This difference does not affect the ability to calculate a benchmark performance measure and future improvements in the inventory turns of the entire supply chain.
- Inventory level should include all non-obsolete parts, even if not shipped during the current month.
- The value of raw materials that are used in both MAP and non-MAP products should be approximated by the use of a driver that best mirrors usage for MAP and non-MAP products. We suggest that companies identify which products the raw material in question is used in, then quantify the total sales for these products. Next, calculate the what percentage of these sales is attributable to MAP products. Multiply the raw material inventory in question by this percentage to obtain the proper raw material inventory level.

Expected findings:

- As the recommendations are implemented, inventory turns for individual companies and the entire supply chain should increase as a result of improved lead time and more accurate data.

3.3.5 Metric 4: Obsolete Material Inventory Dollars

Definition:

Identify all dollars lost on materials deemed to be obsolete at the end of each month as indicated by claims paid to your suppliers that were a result of unplanned schedule decreases, late or incomplete schedule information. Only materials within the scope of the MAP project should be considered.

Method:

The dollars are to be recorded only when a producer pays a claim to a supplier for material within the scope of the MAP project for one of the following two reasons:

- Unplanned schedule decreases by producer.
- Late or incomplete schedule information to supplier from producer.

Recommendations supported:

1, 2, 3, 4, 5, 8, 9

Issues encountered:

- Several companies reported difficulty in quantifying the value of obsolete material in stock because lower tier companies are not always informed when a part number has become obsolete. This was a common misunderstanding of the nature of the obsolete materials dollars metric.
- There is a significant time delay, often 6-8 months after a material is classified as obsolete, before claims are paid to suppliers.

Resolution of issues:

- Obsolete material dollars are to be reported only when a company pays a claim to its supplier due to schedule changes.
- If obsolescence occurred before the MAP project began, companies are not to record as obsolete when the fee is paid.
- The lengthy delay between obsolescence and payment of claim is information may make it difficult to gather a useful measure of obsolete inventory based upon payment of claims. The metrics team must establish whether the metric is likely to have value or whether it is necessary to modify or eliminate this measure.

Expected findings:

- Claims paid for obsolete material should drop as a result of improved information flows.

3.3.6 Metric 5 : Number and Cost of Unplanned Changeovers

Definition:

Companies are to identify the number and cost ($ paid) of unplanned changeovers for any part included in the scope of the MAP Project that were a result of unplanned schedule increases, late or incomplete schedule information. Unplanned changeovers are defined as any deviation from the normal production schedule required for the reasons noted herein.

Method:

Unplanned changeovers should be categorized as either unplanned changeovers caused by late or incomplete schedule information. "Late" is defined as more than 24 hours beyond the time you would normally expect to receive the schedule information.

Recommendations supported:

1, 3, 4, 5, 8, 9

Issues encountered:

- What are costs of unplanned changeovers? Should overtime be included in the cost of unplanned changeovers?
- Historic data often impossible to collect.
- Flexible manufacturers, such as Johnson Controls, rarely have costs of unplanned changeovers.

Resolution of issues:

- Costs of unplanned changeovers are costs of mold changes, die changes, and equipment cleanings that must be performed in order to accommodate a change to the production schedule. Overtime is not to be included in these costs.
- Do not record any costs if no such costs of unplanned changeovers are incurred.

Expected findings:

- Implementation of the recommendations should reduce the number of unplanned changeovers through better and more timely planning information.

3.3.7 Metric 6: Lead Time (information flow)

Definition:

Lead time in information flow can be considered a measurement of how quickly information moves from tier to tier. By measuring how quickly customer requirements are cascaded down the supply chain the impact of the nine recommendations on supply chain information flow lead time can be determined.

Method:

As the customer requirements data is passed down the supply chain, each company should keep a log of when it was issued by the customer and when they received it.

Timing:

Data is to be recorded monthly. This data was collected by independent survey on a quarterly basis.

Recommendations supported: 1, 8, 9

Issues Encountered:

- Confusion as to whether to measure information lead time, production lead time, or both.
- Confusion over how often to report data.

Resolution of issues:

- Measure only information lead time.
- Lead time information need not be submitted monthly. It was collected quarterly.

Expected Findings:

Information flow lead time should decrease.

3.3.8 Metrics Data Collection Method

After establishing and defining the six metrics during phase two, the data collection period commenced. The project team worked with the fifteen companies participating in the MAP to help them begin the

process of collecting and submitting data to the AIAG. In addition to current data, each company was required to submit historical data for the period February '95 to June '95.

Companies generally did not initially submit metrics data for one or more of the following reasons:

- did not understand certain metrics.
- existing systems are not able to generate the required metrics data with ease.
- historical data difficult or impossible to obtain.
- no one directly responsible for the gathering and reporting of metrics data to the AIAG.
- difficulty in starting the process of gathering and submitting metrics data.

Full participation from all MAP partners was essential for the creation of meaningful supply chain metrics. It would not be possible to quantify the performance of the supply chain as an entity if data from one of its links is missing. As such, Wizdom Systems conducted an initial review of every company's metric initiative and worked with MAP partners to correct their problems through training. The initial review was conducted by telephone, with meetings arranged to train company personnel in particular metrics and data collection, as necessary.

The company metrics review identified several issues. Despite the time spent earlier during phase two of the MAP project developing the metrics, companies encountered problems of interpretation when attempting to collect metric data. Conversations with participating companies illustrated that certain metrics were understood and measured differently by different companies. It is crucial that each metric is treated consistently across companies to insure the integrity of supply chain statistics. In most cases, training and clarification of the metrics and data collection methods are successful solutions. In the case of certain metrics, new information has led to rethinking of the original metric's formulation. These and additional issues will be discussed in section 4.

Once initial issues were resolved, each company submitted their metrics data monthly. The data was collected by personnel of the participating companies, who checked it for quality and consistency. Once the data was deemed correct, it was reported to Wizdom Systems, who maintained the central database of each companies complete data. Wizdom Systems then conducted their own quality checks and verified any inconsistencies with company representatives. All subsequent analysis of the collective data set was conducted by Wizdom Systems.

3.4 Use of the EDI Testbed

During the MAP project the Testbed, located at ITI, was used to support the technical implementation effort at several of the participating companies. The Testbed consisted of a dedicated 486 personal computer running MS Windows 3.1. This system was connected to the Internet and the Advantis Value Added Network. The Internet connection was provided by ITI through a DECsystem 5500 gateway. The connection to Advantis was a dial-up connection using a 9600 BPS modem. The primary uses of the Testbed were to assist with the installation and testing of e-mail and EDI systems.

The main e-mail testing support was for companies using the Expedite for Windows E-mail package and the Advantis VAN for e-mail services. This included installing the Expedite for Windows software on the personal computer and establishing a dedicated mail box on the Advantis network. The work in the Testbed was performed prior to installation activities in the field. This minimized problems and delays when actual installation and setup activities began in the MAP firms.

In addition, support for e-mail installation was provided on the DECsystem 5500 for testing of the PINE e-mail system. This was used to support one of the firms that used UNIX as their main operating system.

The Testbed was used to verify all participating companies e-mail addresses prior to publication. This testing included sending and receiving messages to insure address validity and message content.

E-mail was used throughout the second half of the project to coordinate schedules, verify EDI test results, send project status updates and exchange other pertinent project information. The Testbed was also used to assist the AIAG with their communications by providing an OS/2 PPP attachment to ITI systems so that

AIAG MAP project participants would have e-mail service. This support was provided until the AIAG installed their own internal e-mail system with connectivity to the Internet.

Support for the EDI activities of the MAP project was accomplished by installing the Supply Tech STX EDI translation software in the Testbed. Both the STX DOS and the STX for Windows versions were installed on the dedicated personal computer. In addition, a second Advantis mailbox was setup strictly for the testing of EDI transmissions. This capability proved very valuable in the testing of the ASC X.12 830 Release transaction set being passed from Johnson Controls to Atwood Automotive and then on the four hardware suppliers in the Rockford/Chicago areas. This testing insured the accuracy and integrity of the data generated at each step of transmission prior to actually sending the transaction set to the next level of the supply chain.

The final function supported by the Testbed was the ftp site established at ITI to permit the distribution and sharing of project data and documents between ITI, Wizdom Systems and the AIAG. This functionality permitted joint development of several supporting documents as well as project deliverables by the various participants. By establishing this capability, document transfer between AIAG in Southfield, ITI in Ann Arbor, and Wizdom Systems in Naperville was greatly facilitated.

3.5 Simulation

A part of the MAP Project undertook a task using discrete event simulation to evaluate potential improvements in the supply chain. The purpose of the task was to use simulation to help evaluate and choose between different recommendations for improvement across the companies participating in the MAP. Representatives from the participating companies looked at the supply chain process for handling engineering changes. As a result, simulations of some of the companies' internal processes for handling engineering changes were constructed.

As planned, recommendations for improvements from the current situation were formulated. However, because of the nature of the resultant recommendations and the supply chain itself, the use of simulation turned out to be inappropriate. On the other hand, the value of simulation for making improvements within individual companies was more favorable. In the future, a standard approach to simulation may come into use that allows the linking of the companies' individually owned and maintained models into an integrated complex model. This approach may add additional value to simulation in supply chains.

3.5.1 Engineering Change Issues

A consistent theme heard throughout the as-is studies was that engineering changes initiated by customers create difficulty for suppliers, adding substantial time and cost to the production of parts. Because engineering change was not an original focus of the as-is studies, the results were that this was an area in need of further investigation. A sub-group of the MAP participants further investigated the impact of engineering changes, and looked for recommendations that would lower the cost and improve the efficiency of processing them.

One of the goals of the Engineering Change Sub-Group included the use of computer-based simulation in the selection of recommendations for processing engineering changes throughout the entire supply chain. To do this the process had to start by looking at individual suppliers in the chain.

3.5.2 Simulation Software

What type of simulation package should be used? Part of the goal was to choose tools the participating companies could potentially use themselves. The system had to:

- Handle reasonably complex, discrete-event simulation models
- Run on readily available computers
- Be simple to learn and easy to use, given the available capability
- Be low enough in cost to reach small companies

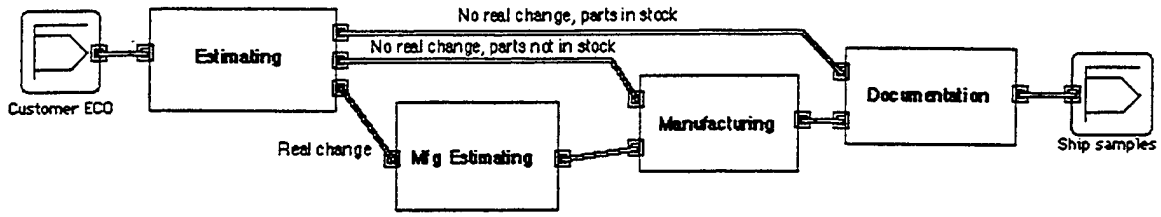

Figure 3-4. Generic Supplier Engineering Change Processing Model

After some research and consideration, a commercial simulation software package called Extend™ [1] was chosen. Extend is a powerful yet reasonably priced tool available on Windows and Macintosh platforms. This software is capable of both continuous and discrete-event simulation and has an easy to learn graphical interface. It comes with rich libraries of building blocks to use for constructing quite complex simulation models. Even though there are simulation packages that have greater capabilities, they were only available on Unix workstations and were harder to learn and use. There were simpler simulation packages available, but their capabilities were too limited.

3.5.3 Simulation Model Construction

Once a simulation package had been chosen, the next step was to begin building the individual simulation models for the companies in the supply chain. This work went on in parallel with the Engineering Change Sub-Group's effort to determine a set of recommendations for the supply chain. Simulation models were developed for some of the supply chain companies. During this process, ongoing discussions and information gathering with the other companies revealed that the basic process used by supplier firms was quite consistent from one company to the next. The differences were primarily in the details.

Building an adequate simulation model of a supplier's engineering change process turned out to take only a few iterations. The personnel involved in model construction felt the approach had quite a bit of potential for helping them look at their internal activities. This was encouraging, but of course the goal was to look at the applicability of simulation to the supply chain as a whole. To do that required a set of recommendations from the Sub-Group.

From a simulation point of view, this similarity is encouraging. It means that a generic model can be built that can serve as a starting point for different companies' own specific models. This generic model is shown in Figure 3-4. The four major boxes result from the requirement that, for any engineering change, a supplier is normally required to submit sample parts. The problem with that requirement is that engineering changes do not necessarily affect the actual part at all. Many are administrative in nature (approximately 30 percent), involving changes to the drawing (electronic or paper) that defines the part but not the part specifications. These include revision numbers for the parent assembly and changes in approval dates. These types of changes are processed through the same engineering change process as a change in part material or geometry. Those changes include the submission of sample parts as well. Accordingly, the generic model shows three paths through the engineering change process in a typical supplier company:

1. The first path occurs when the engineering change is administrative in nature (i.e., no change to the part) and the supplier has stock on hand. In this case, samples are pulled from stock and shipped under the new version of the drawing.
2. The second path occurs when the engineering change is administrative but the supplier has no stock on hand. The supplier then must produce a set of sample parts from existing tooling and then ship under the new version.

[1] Extend™ is a trademark of Imagine That, Inc.

3. The third path occurs when there is a real change to the part. Manufacturing must re-estimate the cost and do any necessary retooling before any sample parts are made for shipment.

In all cases, the first step is to evaluate an incoming engineering change to determine which path it should take. The last step is to assemble the needed documentation before shipping the sample parts. For a more detailed look at a specific example based on the generic model, see Appendix A.

3.5.4 Sub-Group Engineering Change Recommendations

In the parallel activity, the Engineering Change Sub-Group worked to determine a set of recommendations for improving the handling of engineering changes in the supply chain. The result of those discussions yielded the following:

- *Involve the supplier early in any engineering process.* Suppliers have expertise and want to help in the design process. In the long run, both supplier and customer benefit through lower cost, higher quality parts.
- *Establish a process that includes frequent two-way communications.* Frequent, timely, and complete communications between the right people are critical to the smooth implementation of engineering changes.
- *Customers must be aware of and respect suppliers capabilities.* The suppliers have significant knowledge and capabilities that, all to often most customers fail to acknowledge or just overlook.
- *Eliminate engineering changes that do not physically change the part.* If the part does not actually change, why go through a lot of excess costly effort to produce sample parts. It is a function of the blind application of rigid rules, whether appropriate or not.
- *Standardize engineering change information sent from customers to suppliers.* Without standardization, a supplier must work through numerous and varied engineering change documentation approaches. Incomplete information also results from lack of standardization.
- *Standardize the means of communicating engineering change information.* Not only is the engineering change content varied, but also the method used to transmit the information from customer to supplier; EDI, overnight shipping services, fax, and electronic file transfer. All are used, often by the same customer in different circumstances.
- *Customers need to adhere to their own processes.* All too often, a supplier will be told by a customer to use a certain approach, but later commanded to ignore it. This adds to the confusion as well as the cost.
- *Eliminate redundant documentation requirements.* When a batch of parts is being shipped that came from a previous batch, the same full documentation requirements have to be fulfilled. Why not allow documentation by reference in that situation? Pulling together documentation is costly.

Throughout the discussions, the suppliers had no problem with value-added work, such as producing samples or documentation for a part that has actually changed. The objection was clearly aimed toward work that made no contribution to the production of good parts.

3.5.5 Findings

When comparing the different recommendations based on simulation, we came up with the following findings:

1. Simulation of a supply chain as a whole, that is, a set of companies linked in trading partnerships, really does not bring anything to the set of recommendations developed for improving engineering change processes.
2. The recommendations are general in nature and therefore difficult to simulate. An additional step of creating specific implementations for these general recommendations would be required prior to simulation.

3. The high-level process for handling engineering changes is pretty much the same for any supplier, regardless of size or position in the supply chain. The individual company's processes differ primarily in the details of timing and the quantity of resources involved. This finding suggests that a generic engineering change model could be provided to companies that would provide a good starting point for them to address their own internal engineering change processes. This would help suppliers demonstrate the effects of their customers' practices.

4. Engineering changes do not simply pass down a supply chain. Depending on the nature of the change, an engineering change may stop at an intermediate tier. Just as likely, a single change from the OEMs' point of view may resolve into a series or set of changes at the second or third tier. This finding substantially increases the modeling difficulty, because characterizing the nature of the connections between engineering changes down the supply chain is quite difficult. At present, supporting data for modeling this complexity is not readily available, although it could be obtained, theoretically.

3.5.6 Summary

As stated above, the original goal was to compare the potential value of different recommendations using simulation as a means for comparison. Unfortunately, the recommendations of the Engineering Change Sub-Group were general in nature and did not lend themselves to simulation. The project team and the participating companies decided not to further pursue simulation for evaluation of the recommendations. Simulation was effective at looking at a company's internal processes.

The potential still exists for simulation to be valuable for evaluation of recommendations, but the recommendations must be specific. For example, one might come up with a set of possible ways to reduce the number of formal engineering changes that do not involve changes to the actual part. Deciding which approach would be best for the supply chain as a whole might well be a good application for simulation.

3.6 Resulting Tools

The following tools were utilized in information gathering, improvement planning, technical implementation, and metrics at MAP companies (included in the appendix):

- E-mail Plan Template
- Two-way EDI Plan Template
- Integrated EDI Plan Template
- Process Observation Checksheet
- Process Documentation Worksheet
- Baseline Performance Summary Report
- Benchmark Guideline
- Sample Blank Template

4. Relevant Test Results

4.1 Metrics Results

On a high level, the MAP project metrics provide confirming evidence that the implementation of integrated EDI and streamlined business practices generates tangible returns for both individual companies and supply chains.

A summary of the results of the MAP project metrics are illustrated in the following table. It is important to understand that the following table and analysis focuses on whether or not conclusions can be drawn *from the metrics data itself.* While certain metrics did not yield significant results based on the *data submitted by participating companies*, there is often sufficient anecdotal evidence to allow the analyst to draw conclusions with regard to the likely extent of cost savings.

Metric	Hardware	Trim	Seat
1. Dollars Spent on Premium Freight*	n/a	○	n/a
2. On-Time Shipments	●	○	○
3. Inventory Turnover Performance	●	●	○
4. Number and Cost of Unplanned Changeovers	n/a	○	○
5. Obsolete Material Inventory Dollars	n/a	n/a	n/a
6. Lead Time (Information Flow)	●	●	●

● = Positive Results ○ = No significant Results n/a = Not Applicable

Figure 4-1. Summary of Metrics Results

* *Note:* although the metric for dollars spent on premium freight did not show significant results, sufficient information exists to approximate that such savings are likely.

A detailed analysis is included in the discussion of each metric. The most significant gains were made in lead time reduction, inventory turnover performance, and on-time shipments.

We discuss the findings of each metric one by one. The metrics are presented in their original order, rather than by significance of findings.

4.1.1 Metric 1: Dollars Spent on Premium Freight

Overview

Metric	Hardware	Trim	Seat
1. Dollars Spent on Premium Freight	n/a	○	n/a

Due to the structure of the MAP project supply chain, the limited number of MAP parts in the sample, and incomplete data from the trim chain, there was limited spending on premium freight reported. Total annual spending on premium freight amounted to $652,998.

The objective of this metric was to quantify whether the *percentage* of spending on premium freight dollars due to unplanned schedule information decreased as a result of improving information flows within the pilot supply chain.

Companies were required to classify spending on premium freight into four categories:

A. Premium freight caused by unplanned schedule increases

B. Premium freight caused by late schedule information. "Late" is defined as more than 24 hours beyond the time you would normally expect to receive the schedule information.

C. All other premium freight for parts within the scope of MAP

D. Total premium freight for parts within the scope of MAP

While certain companies were able to successfully categorize data, there were several companies who, because of strained resources and insufficient internal systems, were unable to accurately break up the data as required.

The general outcome of this metric, *based upon the data alone*, is inconclusive. This is more a statement of *shortcomings in the data* than of the impact of MAP-type recommendations upon premium freight spending. There exists a wealth of anecdotal evidence gathered at MAP companies which strongly suggests that the implementation of MAP type recommendations does indeed lead to reduced spending on premium freight.

Hardware Chain

The results of the metrics data submitted by the hardware chain are inconclusive. The four third tier hardware suppliers (Dudek and Bock, Rockford Spring, R-R Spring, and Specialty Screw) are all located within close geographic proximity of their customer, Atwood Automotive. For this reason, these suppliers rarely and sporadically paid premium freight to ship product to their MAP customer. Of the four, only R-R Spring recorded regular premium freight payments in the initial months of data collection. These payments stopped in September '95 when the shipping schedule with Atwood was modified. After this point in time, there was essentially no spending on premium freight by the third tier hardware suppliers.

The only company in the hardware chain regularly paying premium freight was Atwood Automotive. Due to limited resources and insufficient internal systems, Atwood was unable to break apart its spending based upon cause. Thus, it is not possible to draw conclusions regarding whether or not the percentage of dollars spent on premium freight increased or decreased as a result of implementing EDI with suppliers and receiving full planning horizons from JCI. With regard to the absolute levels of premium freight paid at this facility, the amount fluctuated from month to month with no clear trend. Furthermore, metrics data from Atwood Automotive ceased in March '96.

If Atwood is removed from the equation, there is virtually no spending on premium freight in the supply chain due to the geographic proximity of suppliers to their customer. With Atwood in the equation, no clear inference can be drawn from the data due its inadequacies. For these reasons, the data gathered with regards

to dollars spent on premium freight in the MAP hardware chain is not sufficient for meaningful analysis. The metric is not applicable to the hardware chain.

Trim Chain

The bottom tier trim chain suppliers, located in the southern states and Mexico, are vast distances from their customers. Unexpected schedule information can result in the expensive chartering of planes to move material from one location to another. Tiny improvements in information flow can lead to large savings.

The raw data received from the trim chain was limited. Two of the bottom tier trim companies did not submit metrics data. Technotrim did not submit data following its withdrawal from the MAP project. Milliken did not submit data for reasons of confidentiality. These two omissions weakened the project team's ability to conduct a full analysis. However, Milliken has reported making significant reductions in premium freight after implementing EDI and reengineering business processes. While not providing actual numbers, Milliken reports significant reductions in premium freight, including the virtual elimination of premium freight charges with one customer after redesigning intercompany processes. John Reagan, Director of Planning and Communication at Milliken Automotive has stated that "our biggest gains have come from the business process improvements, not the technology alone." Thus, despite the lack of data from the trim side of the chain, extensive anecdotal evidence exists that implementing MAP type recommendations leads to reductions in premium freight.

Out of the five trim plants who submitted metrics data, only two companies consistently reported spending *any* dollars on premium freight. Of these two companies, only one company was able to break its spending into the components caused by late or unplanned schedule information and the component from all other causes. The second company reported all spending in all months as caused by late or unplanned schedule information.

The following graph depicts the percent of dollars spent on premium freight in the trim chain that was reported as due to unexpected or late schedule information.

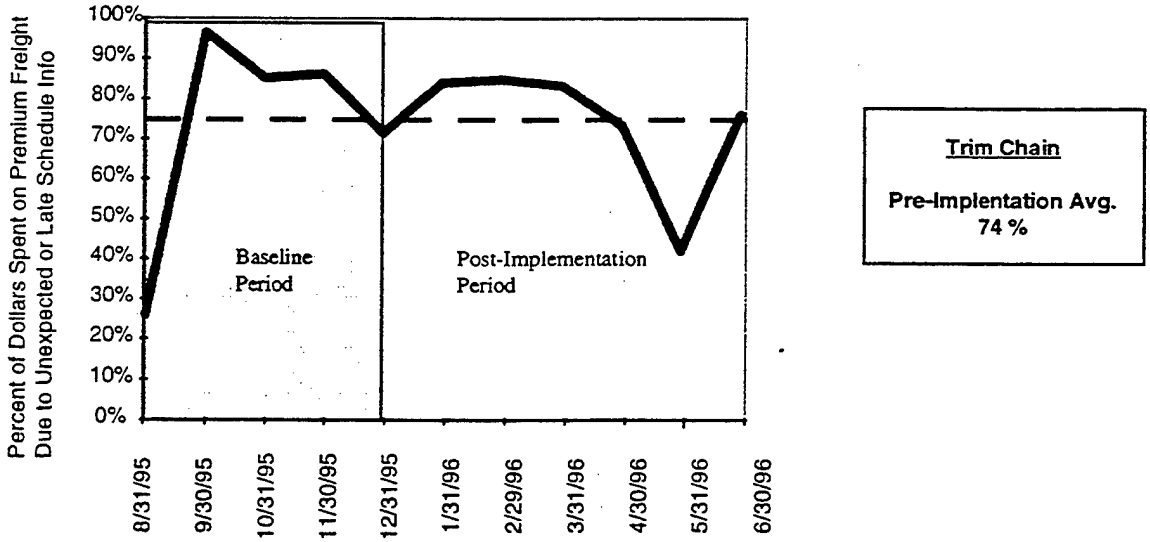

Figure 4-2. % of Dollars Spent on Premium Freight Caused by Unexpected or Late Schedule Information in the Trim Chain

The month of September has been included as a data point in the graph, but excluded from the calculation of the pre-implementation average due to an exceptionally high level of premium freight recorded that month. One trim company reported spending $248,000 on premium freight due to unplanned schedule information. This represents over one third of the entire $652,998 annual spending reported by the entire

supply chain. To include this figure in the average would have yielded a baseline average of 91%, which would have caused normal levels of spending on premium freight to falsely look like improvement.

While the graph appears to give evidence to the eye of a general trend towards decreasing spending through May of 1995, it is important to look closer at the data before drawing such conclusions. As mentioned above, the majority of the spending reported comes from only two companies, Company X and Company Y, which classified 100% of the spending as due to unexpected schedule information at all times. Further, Company Y reported no premium spending, whatsoever during the period August 1995 through March 1996. The main difference then, between the graph of the trim chain and the graph of Company X, who submitted consistent, reliable data, is that the trim chain appear to have a higher percentage spent due to unexpected schedule information than does Company X in the months April through June 1996. This is due to the impact of Company Y's recurrence of spending, all of which is classified as due to unexpected or late schedule information.

The following graph depicts the percentage of premium freight dollars spent due to unexpected schedule information at Company X, the single trim company who was able to correctly report the data. Note that the only difference between this graph and the graph for the entire trim chain is the slightly lower percentages in the months April through June 1996 for the above-mentioned reasons. Company X presents the most representative picture of spending on premium freight that can be taken from the trim chain.

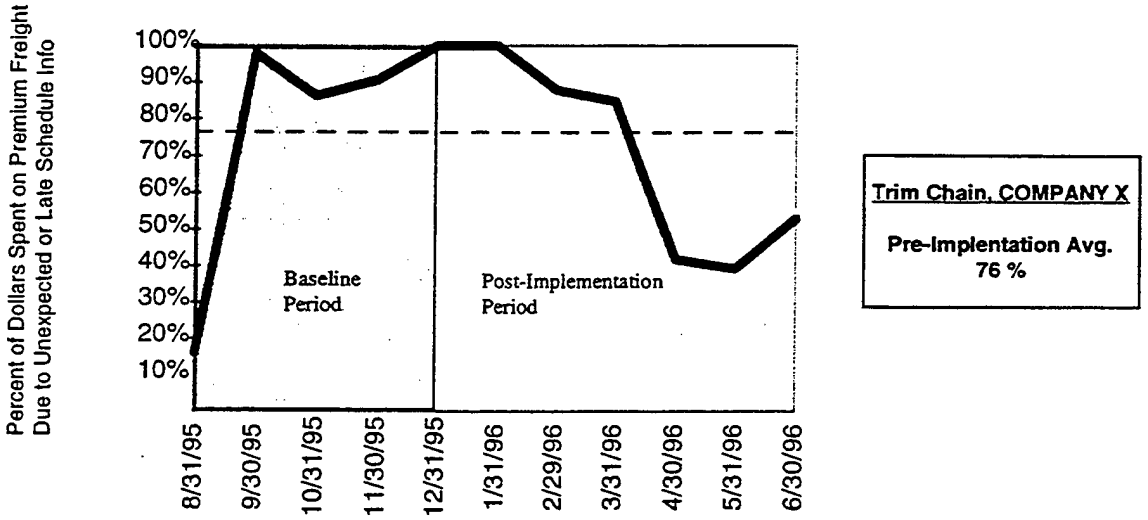

Figure 4-3. % of Dollars Spent on Premium Freight Caused by Unexpected or Late Schedule Info: Company X in the Trim Chain

The percentage of spending on premium freight at Company X due to unexpected schedule information increased radically towards year end, due largely to unexpected schedule changes associated with balance out. The percentage drops consistently in the first five months of 1996 due to large increases in premium freight from causes other than unexpected or late schedule information. While the trend appears positive on the surface, the level of spending on type A and B premium freight remaining relatively constant through these months. The lack of historical data prevents us from looking at the effect of the timing on the numbers reported. For these reasons, it is not possible to draw significant conclusions from this data.

Seat

The Johnson Control seat assembly plants deliver seats Just-in-Time in sequence to the OEMs. Each plant is located approximately a half hour drive from its customer. Due to the close links and frequency of scheduled deliveries between JCI and the OEMs, there is extremely limited spending on premium freight on

outbound seats. JCI plants do pay premium freight for expedited shipments from suppliers when JCI is at fault. JCI plants reported minor, varying amounts of premium freight dollars for these type of situations. In all cases, with one exception valued at $2,500, the spending on premium freight has been caused by reasons other than unexpected or late schedule information. Thus, no significant findings with regard to spending on premium freight were observed in the JCI data.

Summary of Analysis of Dollars Spent on Premium Freight

In sum, the data alone on dollars spent on premium freight in the trim chain does not allow one to draw significant conclusions.

However, as mentioned above, there is a great deal of evidence in support of the claim that improved information flow generated through linking a supply chain electronically lead to better, more timely information which reduces spending on premium freight. Milliken reported significant reductions in spending on premium freight as a result of EDI and changing business processes. The following quotes from MAP participants are typical of the observations and experiences of MAP project participants.

> "Right now, as far as premium freight goes, we have about some $800 a month.* We feel that if we had better information that would lead to about a ninety percent savings right there."
>
> - Russ Johansson, President, Specialty Screw
>
> * Includes non-MAP customers. Premium freight for Specialty Screw within the MAP project was zero, due to close geographical proximity to Atwood.
>
> "When we don't get that information then we're working on false numbers and you have to make assumptions because you're not really sure what they (the customer) really want. That leads to increased cost in your manufacturing and also, inevitably you're spending more dollars on premium freight."
>
> - Maureen Young, Lear Favesa

For these reasons, it is reasonable to conclude that reductions in premium freight are achieved through improvements in information flow and improved processes.

4.1.2 Metric 2: On-time Shipments

Overview

Metric	Hardware	Trim	Seat
2. On-Time Shipments	●	○	○

On-time shipment is a valuable measure of both quality and customer satisfaction.

The objective of this metric was to quantify whether the *percentage* of on-time shipments from suppliers to customers improved as a result of improving information flows within the pilot supply chain.

MAP participants were required to report the data as follows:

The percentage of product shipments completed and shipped in accordance with the originally agreed-upon ship date for all parts included in the scope of the MAP project. A supplier's shipments will be on-time when the total scheduled quantity for a given part number is shipped on the agreed-upon ship date; late shipments and early shipments (except those early shipments due to a customer's request or due to standard pack quantities), are not considered on-time. The ship date for a part is defined by the customer schedule authorizing shipment or by the agreed to conversion of a delivery date/time.

$$\% \text{ On-time shipments} = \frac{\text{Number of on-time part number shipments}}{\text{Total scheduled part number shipments x 100}}$$

Improvements in on-time performance were primarily observed within the hardware side of the supply chain. Significant seat and trim-chain improvements were not observed because almost all trim-side companies were shipping orders at a 100% on-time rate prior to the MAP project beginning. Therefore little improvement was possible

Hardware Chain

The 5.7% average improvement in on-time shipments for the hardware is equal to a five percentage point increase. The average on-time shipping rate, 88% prior to EDI implementation, increased to 93% six months after implementation. Prior to the increase, the on-time shipping rate fell substantially as a result of a doubling of orders for one of the chain's companies. Over a period of a couple of months, this company was able to utilize the better and quicker information it was receiving as a result of EDI and ultimately improve its on-time shipping performance above its previous average. Over the same period, other chain companies also showed improvement in on-time shipping rates.

Trim Chain

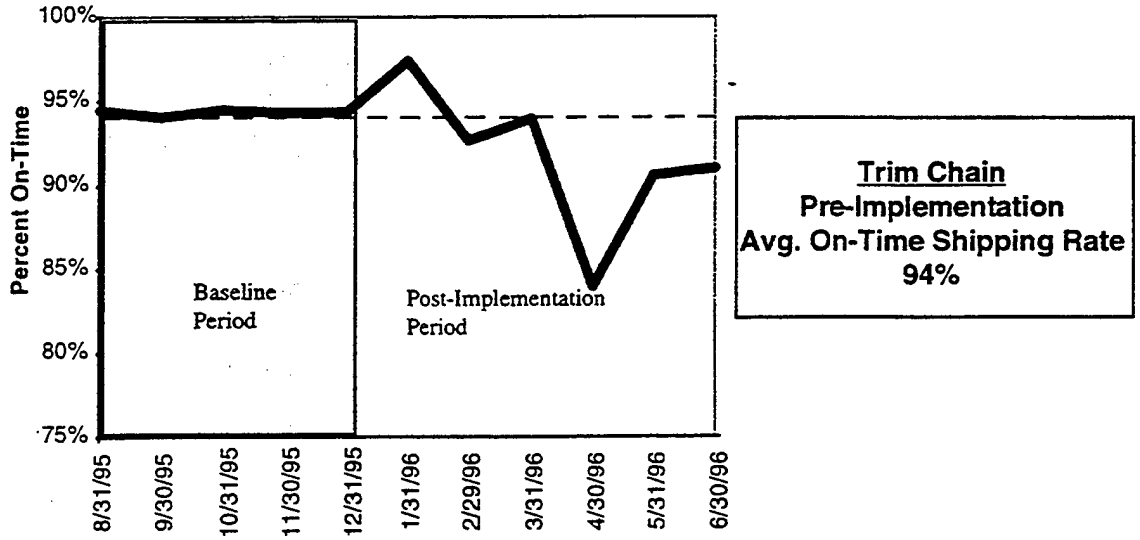

Figure 4-4. On-time Shipments: Trim Chain

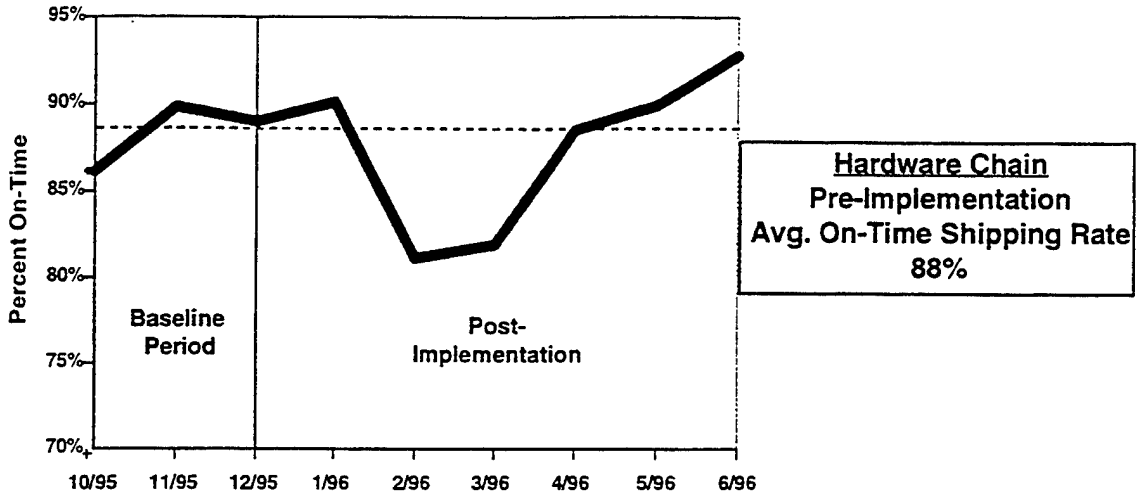

Figure 4-5. On-time Shipments: Hardware Chain

Of the five trim companies who submitted metrics data, four consistently reported on-time shipments of 100% In the above graph, all variance from 100% is due to the effects of the data of one particular company.

Discussions with this company revealed that the decline in on-time shipments visible in the first six months of 1996 is due exclusively to non-MAP factors. For these reasons, it is not possible to attribute any improvement or regression from a baseline average for the trim chain to MAP implementations.

Seat

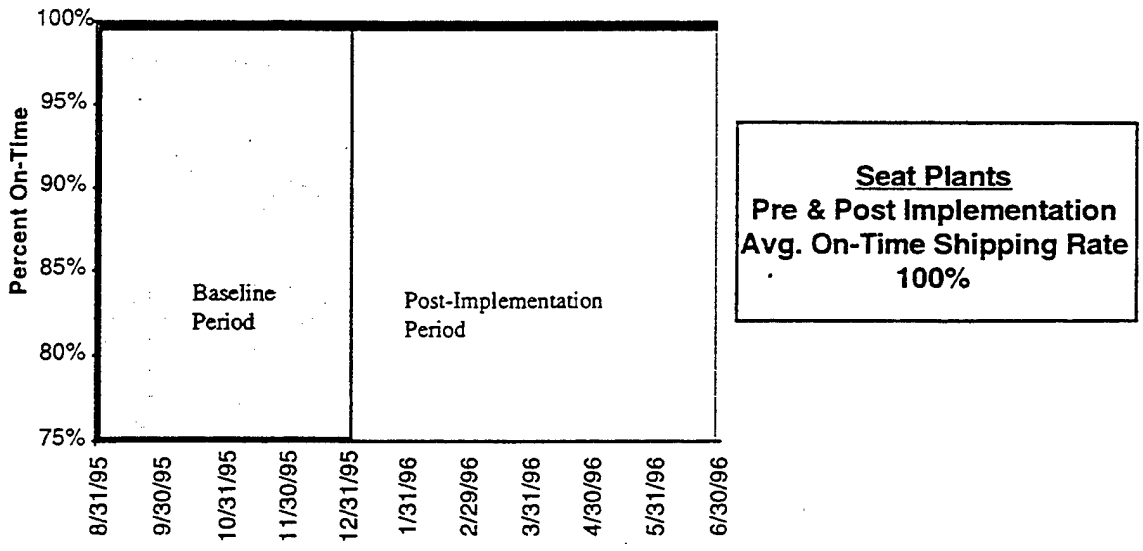

Figure 4-6. On-time Shipments: Seat Chain

The world-class material flow between the OEMs and the first tier seat supplier is evidenced clearly in the above graph. JCI's Sequenced Part Delivery (SPD) and Just In Time (JIT) system delivers seats to the OEMs on-time 100% of the time. No deviation from this average was observed during the months of data

collection. For this reason, no improvement or regression can be attributed to MAP improvements. Rather, JCI offers evidence that 100% on-time delivery is an achievable goal.

4.1.3 Metric 3: Inventory Turn Performance

Overview

Metric	Hardware	Trim	Seat
3. Inventory Turnover Performance	●	●	○

Suppliers hold inventory to hedge against the risk of the unknown. It is a form of waste that can be removed from the system. A customer receives no value from a pile of springs, screws, or seats on a factory floor or in a warehouse. By gaining better information and the ability to react quicker, companies are able to trade information for inventory. This is significant because holding inventory is expensive. It ties up capital that could be invested elsewhere, and necessitates the bearing of significant inventory carrying costs.

MAP participants were required to monthly data on total sales dollars and total inventory level (raw, WIP, and finished goods) for parts associated with the MAP project. Inventory turnover performance was calculated from this data.

Inventory turn performance was expected to show improvement with the implementation of integrated EDI and reengineered business processes. Quicker and more accurate information regarding a customer's future material requirements allow companies the ability to work with actual numbers as opposed to forecasts. With fewer surprises, suppliers no longer need to carry "just in case" inventory. Further, reduced information flow lead times gives producers a longer time frame within which to produce the product. In theory, for every day of lead time reduction, a producer should be able to reduce its inventory by a day's average inventory. Thus, a five day reduction in lead time should yield a reduction in average inventory levels by five days worth of inventory. One small MAP company, who did not report financial data, claims that receiving information sooner allowed them to make a valuable process change. The company was able to shorten production runs from twelve weeks to eight weeks and reap a corresponding reduction in work-in-process inventory of $500,000. This is a striking example of how an improved information flow can lead to significant cost savings.

Evidence of inventory reduction, and the corresponding increase in inventory turnover performance was reported in both the hardware and trim chains.

Hardware Chain

The hardware chain improved inventory turns by 16.7% and the trim chain showed a 23.5% improvement.

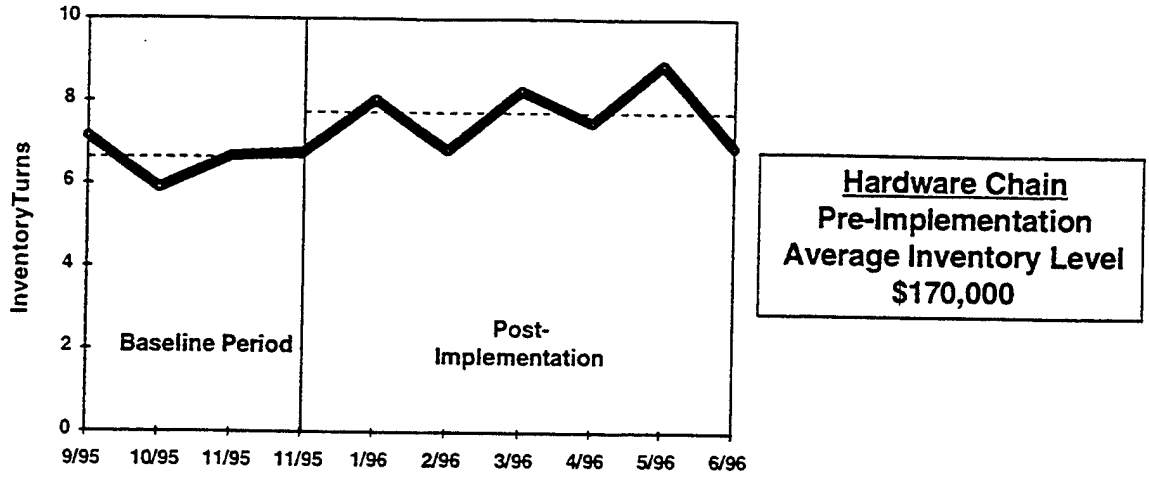

Figure 4-7. Inventory Turns: Hardware Chain

The hardware chain improved from 6.6 inventory turns prior to the implementation of EDI to 7.7 following. This amounts to an inventory reduction of $25,000 on a pre-implementation level of $170,000. As a result, $25,000 in cash was freed up for these companies, many of which are small companies who live and die by cash flow. More so, carrying inventory necessitates the bearings of several costs: cost of capital, handling costs, storage costs, and administrative costs. Traditionally, these costs run anywhere from twenty to forty percent the value of the inventory and tend to vary in proportion to inventory levels. Using a 25% carrying cost of inventory, the hardware chain saw $6,250 in bottom line savings from MAP parts. Feedback from officers at these companies confirm these improvements and that MAP project recommendations were responsible to a significant extent. While this dollar value may not seem extremely large, it is crucial to bear in mind that MAP parts make up approximately one percent of total business at these companies. Had such a magnitude of improvement been made with all customers, these companies would have seen an inventory reduction of $2,500,000 collectively, and a collective savings to the bottom line of $625,000.

Trim Chain

The trim chain also reported significant improvements in inventory turns. An increase in inventory turns of 15.3 to 18.9 accounts for an inventory reduction of slightly over one million dollars for the chain that previously had carried $5.3M of inventory.

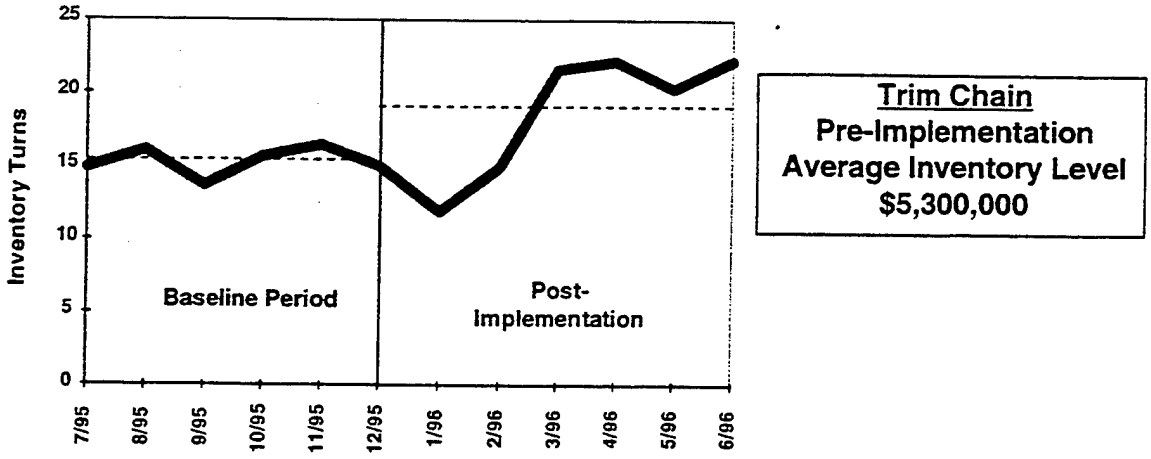

Figure 4-8. Inventory Turns: Trim Chain

Many of the trim companies were involved in improvement efforts other than MAP during the time that the data was collected. Company representatives had difficulty distinguishing between the impact of MAP-type improvements and those outside of the scope of MAP recommendations. However, all agree that improvements in information flow have allowed them to carry less inventory. Ten percent is a conservative estimate.

The value of this improvement at the rates reported by trim companies is:

Inventory Reduction (available cash increase)	$1,000,000
Net Savings (calculated at 25%)	$250,000

MAP parts represent, on average, 8% of all business for the trim chain. Thus, were this type of improvement to be seen with all customers the results would be an inventory reduction of $12.5 million dollars and a net savings of $3.13 million dollars to the bottom line.

The value of MAP type improvements, utilizing a conservative 10% estimate is:

Inventory Reduction (available cash increase)	$100,000
Net Savings (calculated at 25%)	$25,000

Utilizing the conservative numbers, we arrive at an inventory reduction of $1.25 million dollars and a net savings of $313,000 dollars to the bottom line were the trim chain pilot companies to implement such changes with all customers.

Seat

Johnson Controls did not implement significant, MAP-related practices that would lead to a reduction in inventory levels. For this reason, any trends in the data can not be attributed to MAP-type improvements. It is, however, of interest to point out the quantum leap in inventory turns between the first tier seat suppliers and the lower tiers. In accordance with JIT principles, the JCI seat assembly plants operate with an absolute minimum of inventory. It is not uncommon for such a plant to show over 300 inventory turns per year.

There are many tier one suppliers in the automotive and other industries who do not operate at the levels of the seat assembly plants in the pilot project. For these plants, it is to be expected that the implementation of MAP-type improvements will lead to reductions in inventory levels and increased inventory turnover performance.

4.1.4 Metric 4: Number and Cost of Unplanned Changeovers

Overview

Metric	Hardware	Trim	Seat
4. Number and Cost of Unplanned Changeovers	n/a	○	○

Poor information leads to crisis situations. Production runs are stopped, costly changeovers are incurred, and the downstream costs of quality and schedule disruption can often be several times greater than the cost of the changeover itself.

> "every time we make a changeover set up, especially for a crisis situation, it's money that's being lost and somehow that gets made up in the general course of business."
>
> - John Mink, President, Rockford Spring

By improving the flow of information through the supply chain, suppliers are less likely to "get surprised" and incur the lost time, productive capacity, and expense of unplanned changeovers. The goal of this metric was to capture any savings gained from a decrease in the frequency of such changeovers for MAP parts before and after the implementation of integrated EDI and process changes through the supply chain.

Pilot companies were asked to submit the number and cost (dollars paid), of unplanned changeovers for any part included in the scope of the MAP Project that were a result of unplanned schedule increases, late, or incomplete schedule information. Unplanned changeovers are defined as any deviation from the normal production schedule required for the reasons noted herein.

Unplanned changeovers were categorized as either unplanned changeovers caused by late or incomplete schedule information. "Late" is defined as more than 24 hours beyond the time you would normally expect to receive the schedule information.

The metric did not yield significant results, due largely to the idiosyncrasies of the MAP chain, the inability of several companies to effectively track unplanned changeovers, the lack of complete data from all companies, and the relatively small percentage of MAP parts in the hardware (1% of total business), and trim chains (8% of total business).

For these reasons, only two companies reported incurring unplanned changeovers at all. Several companies reported the existence of such changeovers but were unable to a) record the changeover at all due to 'insufficient resources,' or b) distinguish when the changeover was a result of unexpected schedule information. All companies were unable to provide historical data on this metric.

Although the results of this metric were inconclusive, *based solely upon the metrics data*, there is little doubt that suppliers receive fewer surprises and are forced to stop production runs and do an unplanned changeover when lead time is reduced throughout a supply chain.

There is unanimous agreement on this point among the MAP suppliers. The savings are significant. It is legitimate and reasonable to expect that implementation of MAP-type practices in a supply chain will lead to a reduction in this form of waste.

Hardware Chain

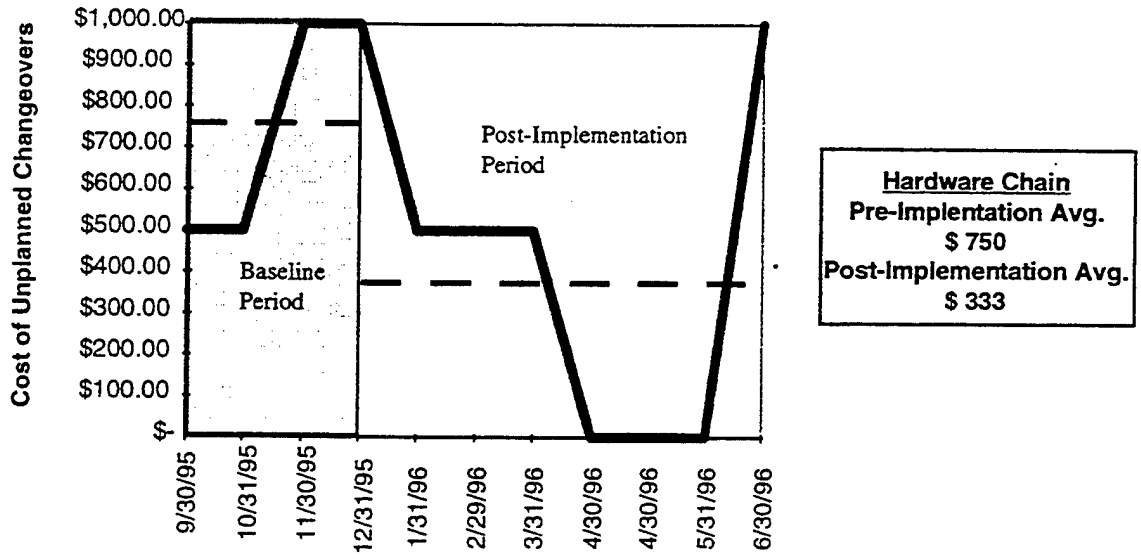

Figure 4-9. Cost of Unplanned Changeovers: Hardware Chain

Only one company in the hardware chain reported metrics data for unplanned changeovers. This data is reflected in the above graph. Conversations with the remaining companies revealed that unplanned changeovers are part of the general course of business, caused by late arriving schedule data.

This company consistently reported 0, 1, or 2 unplanned changeovers for MAP parts per month. Because of the variation in frequency of unplanned changeovers, a longer data series (or a larger sample of parts), would be required to judge whether the number of changeovers is truly decreasing.

Note that the cost of unplanned changeovers reflected in the above graph is a simple estimate of $500 per changeover. This does not include downstream costs of quality and schedule disruption which, in fact, cause the cost of each changeover to be several times higher.

Trim Chain

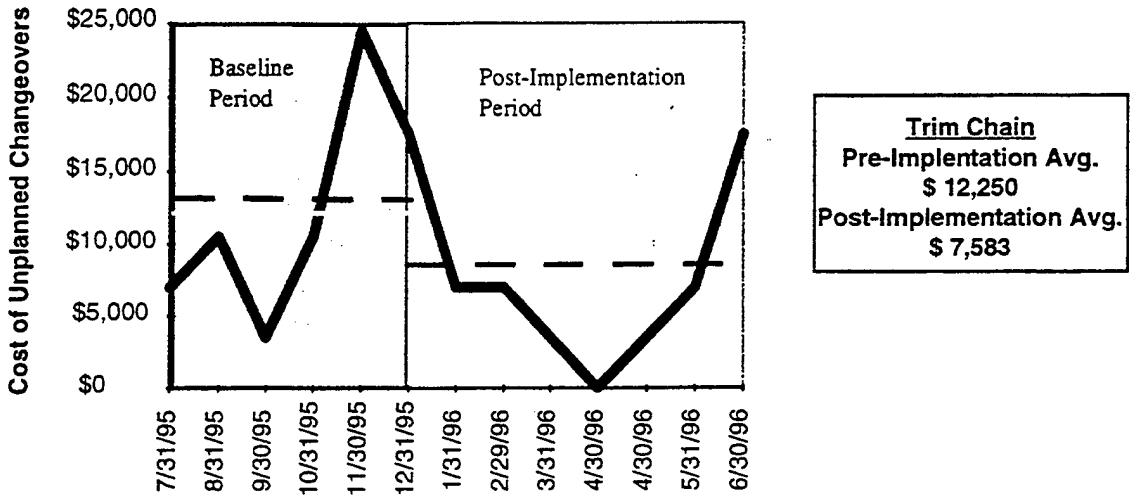

Figure 4-10. Cost of Unplanned Changeovers: Trim Chain

As mentioned previously, the above data comes from only one company. Despite the reduction in the average amount spent on unplanned changeovers during the baseline period and the post-implementation period, this company had already implemented MAP-type practices on its own *prior* to the collection of metrics data. Thus, it is not realistic to credit the MAP project with the improvement shown above.

The cost figure of $2,000 per changeover includes an approximation of downstream costs. In this respect, it is a more realistic valuation than the $500 per changeover utilized by the one company in the hardware chain.

Seat

The flexible manufacturing systems of the seat assembly plants did not incur any changeover costs during the entire period of data collection.

4.1.5 Metric 5: Obsolete Material Dollars

Overview

Metric	Hardware	Trim	Seat
5. Obsolete Material Inventory Dollars	n/a	n/a	n/a

Pilot participants were asked to report monthly all dollars lost on materials deemed to be obsolete at the end of each month as indicated by claims paid to their suppliers that were a result of unplanned schedule decreases, late, or incomplete schedule information. As with all the metrics, only materials within the scope of the MAP project were to be considered.

As the data collection period progressed, it became clear that there was a flaw with the formulation of the obsolete material inventory dollars metric. Companies tend to pay charges to their suppliers on an annual or biannual basis. Thus, all companies submitted a zero value for almost all months. As data is only being collected for a period slightly over a year, most companies will yield one, or at most two, data points.

During late fall of 1995 there was discussion of re-formulating the metric such that companies would report obsolete material inventory dollars for the month that the payable was booked. Further investigation revealed that existing systems and processes within a significant number of the pilot companies were not sufficient to capture this data. As a result, the obsolete material dollars metric did not generate meaningful data.

There is little question that there are significant amounts of obsolete inventory in the supply chain. To some extent, this waste was picked up by the inventory turnover performance metric.

4.1.6 Metric 6: Information Flow Lead Time

Overview

Metric	Hardware	Trim	Seat
6. Lead Time (Information Flow)	●	●	●

Information flow lead time is a measure of how quickly material release information cascades down the supply chain. At the outset of the MAP project, it took over one month for this information to move from the top of the chain to the bottom. The initial phase I analysis of the project determined that lead time is one of the key drivers to waste in the system. Long lead times cause information to arrive late and inaccurate to lower tier suppliers. Bottom tier suppliers, who have the longest material lead times are hardest hit by long lead times. Material lead times on the trim side of the chain are seven weeks. At the project's outset, by the time the material release reached the bottom tier suppliers it was already out of date and useless. These suppliers have no choice but to do their own forecasting, to build excessive just-in-case inventories, and to pay premium freight and make unplanned changeovers to respond to unexpected changes in demand.

MAP project participants were asked to keep a log that recorded the date and time of the moment they received in incoming material release their customer and the date and time they sent an outgoing material release. For bottom tier companies who do not send material releases, their end point was the moment when the release information had passed through their shop scheduling systems such that they were able to order raw materials if need be.

Customer and supplier data was checked against each other to properly determine the true start and end points of each company's lead time. The start point is the moment the material release is available to the

supplier whether or not he/she takes action upon it. If the release comes by mail, it is the day and time the envelope arrives. If the release comes by EDI, it is the moment the release is available at the VAN. The end point of company lead time is the moment that the release is available for their supplier to take action upon it using the same definition.

Lead time at each tier was measured by the longest lead time per tier. Thus, in the following figure, the lead time for the tier that contains companies A, B, and C is seven days--the longest lead time of the three companies.

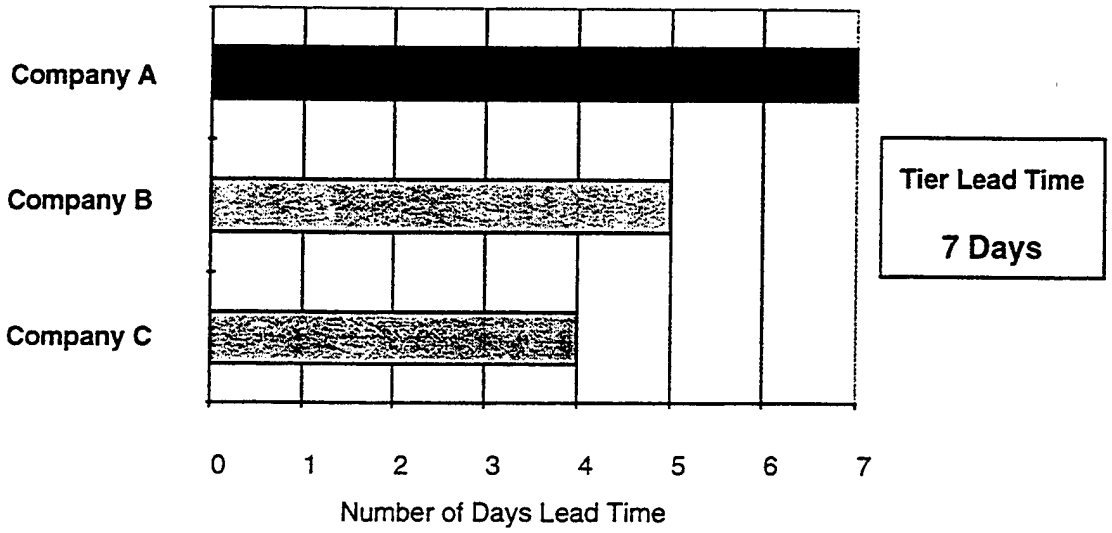

Figure 4-11. Calculating Tier Lead Time

Lead time for the supply chain is, quite simply, the sum of the lead times at each tier.

It was anticipated that by implementing MAP project recommendations, significant reductions in lead time could be made. In fact, significant gains were achieved.

Hardware Chain

After implementing and integrating EDI and streamlining business practices, the hardware chain made a 58% reduction in lead time, from twenty-six days to eleven days.

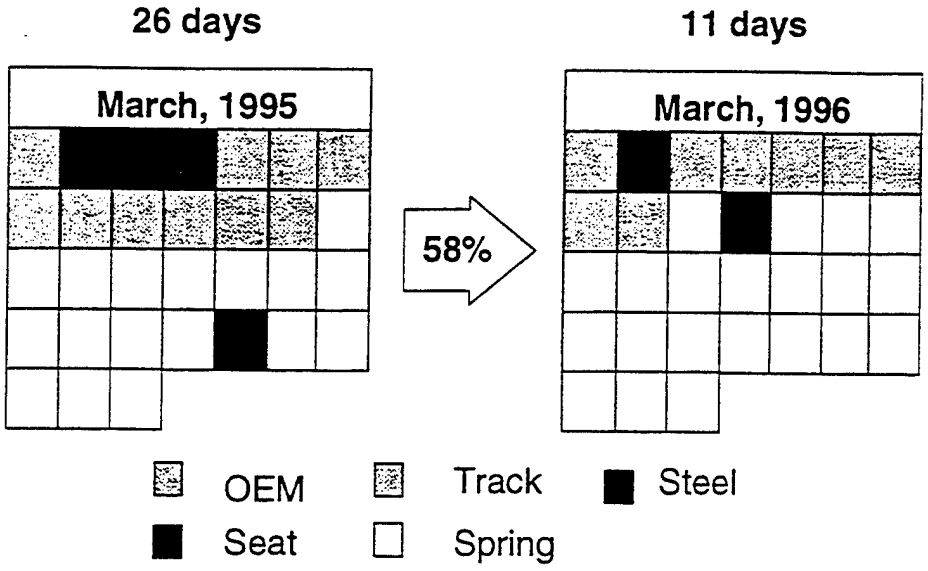

Figure 4-12. Information Flow Lead Time: Hardware Chain

The hardware chain displayed significant improvement at each tier within the chain. Of the overall improvement of 15 days, two days were eliminated at both the first and second tiers and an impressive eleven from the third tier. The improvements at the top two tiers were predominately produced by improved business processes while that at the third tier was from a combination of the initial implementation of EDI itself as well as improved business practices. Where did the lead time reductions come from?

Tier 1

At the first tier, JCI began the MAP project with fully integrated EDI and a processing time of three days. JCI was able to reduce lead time from an average of three days to one through process changes.

Tier 2

There was only one second tier seat track producer, Atwood Automotive. Despite possessing integrated EDI, Atwood still took almost two weeks to move release data to its suppliers due to inefficient processes and an antiquated MIS. At the outset of the MAP project it took Atwood an average of twelve days to get a material release to its suppliers from the moment it received the release from JCI. Atwood sent releases to its suppliers by mail, which added an unnecessary three days to tier two lead time. The first change that Atwood made was to begin faxing its supplier material releases, dropping three days off lead time. In the fall of 1995, Atwood began sending its releases by EDI to its suppliers. The release typically went out every Wednesday. Atwood personnel made an important observation that enabled a lead time reducing process change. Supplier material release information was always available on Monday, yet was not sent out until Wednesday because it was checked and double checked by various individuals. However, the release almost never changed during these two days. Atwood changed their process to send the release out on Monday, thus reducing lead time by another two days to seven days.

Process improvement sessions determined that lead time could be further reduced by several more days through additional process changes. However, these changes were not made due largely to a lack of commitment to the goal. Atwood's existing and antiquated information system stood as an obstacle to achieving one day cycle time. To do so required a new MIS. In the spring of 1996 Atwood was purchased. The new owner intends to replace the Atwood MIS and make radical changes to the existing production and scheduling processes at Atwood. It is anticipated that these changes will enable significant reductions in lead time, quite likely dropping it down to one day. When tier two lead time is one day, the entire lead time for the hardware chain will have dropped from one month to one week.

Tier 3

The bottom tier hardware chain companies possessed extremely long lead times at the beginning of the project, all taking from one week to two weeks. Thus, tier three lead time was two weeks.

The longest lead time at the outset of the project was the two weeks it took R-R Spring to receive and process order information. At the time, R-R did everything manually. After computerizing their operations and implementing EDI, R-R dropped its cycle time down to one week. In the spring of 1996, R-R staff made a simple process change that dropped the lead time from one week down to three hours.

Trim Chain

The trim chain reduced lead time by thirty-two percent, from nineteen to thirteen days. Improvement for the supply chain was six days.

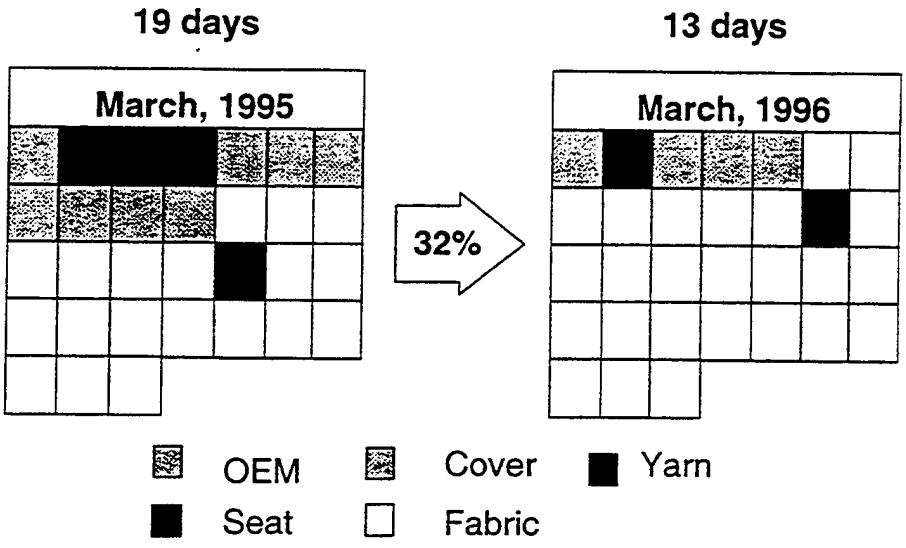

Figure 4-13. Information Flow Lead Time: Trim Chain

Tier 1

At the first tier, JCI began the MAP project with fully integrated EDI and a processing time of three days. JCI was able to reduce lead time from an average of three days to one through process changes.

Tier 2

Integrating EDI and implementing process changes led to a reduction of lead time at the second tier from seven days to three. Within the second tier are companies who consistently receive, process, and send out material releases within or less than three days.

Tier 3

Tier three currently has the longest lead time in the trim chain. Due to the lack of metrics data from Textileather and Milliken, the lead time for the third tier is based solely on Collins and Aikman. Although Collins and Aikman did not show improvement during the course of the data collection period, significant

efforts are underway that drop lead time. Process analysis has been conducted that has identified the "black hole" that is causing long lead time.

The following chart offers another view of lead time.

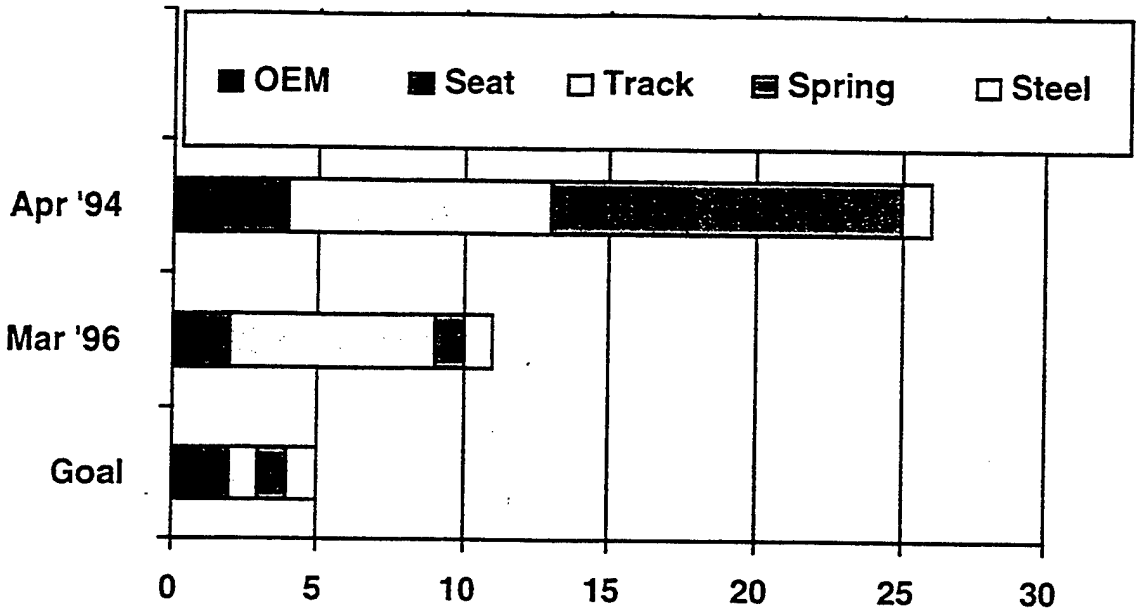

Figure 4-14. Goal: One Day Per Tier

The results of the lead time metric indicate that the goal of one day lead time per tier and one week for the entire chain is clearly achievable.

4.2 Lessons Learned

4.2.1 Managing Change and Project Management

The implementation phase demonstrated the importance of buy-in and commitment at each company. The world is full of good ideas that are not implemented because key players feel no ownership of the plan. With this in mind, the project team created buy-in at each company by involving each company's project manager in the creation of the company implementation plans for EDI, e-mail, and integrated EDI. By doing so, the plans were viewed as *company* plans as opposed to externally created suggestions by the individuals responsible for implementing the plans. To further bolster support for the plans, management review meetings were held at the five Rockford area firms to secure high level management commitment and increase awareness. For the most part, participating companies were engaged and active in the MAP project.

A small subset of companies, however, did not display the required level of commitment. These cases further demonstrated the importance of an internal champion. For example, Atwood Industries, as a second-tier seat track supplier represents an important link in the supply chain. Due to internal business situations, Atwood personnel felt overwhelmed by their day-to-day work and could not commit to full implementation of the MAP project recommendations. The company was preoccupied with putting out fires. Ironically, the MAP project offered a mechanism for eliminating or reducing the root causes of several of these fires. In the summer of 1995, the team was able to secure a commitment from Atwood to pass the 830 material release with the full OEM planning horizon down to its suppliers. Although this insured that the supply chain would possess an unbroken EDI chain, the company could not commit to making process changes internally

or with suppliers and customers, or providing important metrics data. Under the assumption that the "right" people at Atwood simply did not know of, or understand the benefits of the MAP project, the project team made a concerted effort to identify a high level manager who could function as an internal champion of the MAP project. Contact was made with the vice president of manufacturing, a key player who had been entirely unaware of the MAP project due to breakdown of Atwood internal channels of communication. With this player's assistance, the team is currently in the process of increasing Atwood's involvement in the project.

4.2.2 Benchmark vs. Typical Case: Impact of Internal Business Processes

The participating companies range from the OEMs and their first tier suppliers who operate on a Just In Time (JIT) and Sequenced Part Delivery (SPD) to small, hardware manufacturers who depend largely upon manual systems, maintain large inventories, and regularly ship late to customers. Generally, the upper tier companies entered into the MAP project with EDI already implemented and efficient internal business processes. Information comes in, is exploded into supplier part numbers as it passes through internal business systems, and is passed down to suppliers with little to no distortion of the original data. Such companies offered, to varying extents, a benchmark case of EDI implementation. The "typical case" is distinguished by less efficient internal processes and the distortion of data as it passes from tier to tier. In implementing the MAP project recommendations at such companies, it is necessary to look beyond the simple question of "does this company possess fully integrated EDI?" and additionally analyze the quality of internal business systems that can contribute to the passing of faulty or delayed data through the supply chain. Such factors include, but are not limited to, accuracy of inventory systems and accuracy of bill of material.

4.2.3 Interoperability of Implementations

The recommendations developed in Phase One were based on the notion that if all members of the supply chain adopted the recommendation, then the system as a whole would operate more efficiently. The recommendations assumed interoperability. For example, if two trading partners both adopt e-mail for supplementary communications, there was an assumption that they could communicate with each other. This assumption is not always true. In the example, if one company adopts X.400 style e-mail and the other adopts Internet style e-mail, they will not be able to communicate without a provider supplying translation service.

Ideally, recommendations would be specific enough to insure interoperability. This was true of the 2-way EDI recommendation that identified specific ASC X12 transactions. Because of the group process used for recommendation development, recommendations were formed that were somewhat general. These general recommendations avoid politically tough choices. When the resolution of the interoperability issues are put off until implementation, solutions get complex.

In MAP, the issue of interoperability became evident for the following recommendations:

- E-mail for supplementary communications
- Supplementary communications for large changes
- OEM operating plan available on request

In each of these cases, the resolution strategy was unique.

In the case of e-mail, a separate work group at the AIAG was developing a recommended practice for e-mail implementation. It was then straight forward for MAP to follow this AIAG guideline. The AIAG E-mail Guideline recommends supporting both X.400 and Internet style e-mail. The implementation plans for the participating companies were built to meet the AIAG guideline as a minimum while working toward industry "best practice" solutions. A document was reviewed by the project team which describes these technical differences. A copy of the document is included as Appendix A of this report.

In the case of supplementary communications for large changes, the project team decided to resolve the issues of the method of communication and the trigger level of a "large change" to individual trading partner pairs. This solution is inefficient because each company needs to build systems to satisfy the

individual needs of each of its trading partners. The complexity of this approach may limit broad adoption of this recommendation.

In the case of OEM operating plan, each OEM has adopted their own approach. There has been no attempt at interoperability. Suppliers to multiple OEMs need to support multiple systems. Chrysler has led the implementation of this recommendation. Chrysler sends a standard 864 text transaction that contains the operating plan data. This method allows suppliers to directly input this data into their information systems for forecasted product volumes. Ford sends a FAX with operating plan information. General Motors has not yet decided how to transmit this information to suppliers.

4.2.4 Specificity of Recommendations

There was an issue regarding the business use of e-mail recommendation. The MAP recommendation states that "E-mail should be used for non-EDI communications with trading partners, i.e., for exception and supplemental communication so long as its use will meet the immediate needs of the situation." This recommendation is general and difficult for implementers to know when implementation was complete. A set of business uses for e-mail was proposed and is included as Appendix B of this report. After several attempts, the project team was not able to reach consensus regarding specific uses. It was later decided that e-mail would be used to communicate notice of large schedule changes when lead time permitted. It would also be used as confirmation of these notices when alternate methods (telephone or FAX), were used.

Once a specific use was defined, it was then possible to implement specific business practices that support that use. It is now also possible to validate a participating company's compliance with the recommendation.

4.2.5 Agreement with recommendations

The first MAP recommendation, 2-way EDI, identifies specific ASC X12 transactions that should be used between trading partners. This set of transactions was selected using existing guidelines and agreed to by the project team. During implementation, however, it became evident that company support for the 2-way EDI recommendation did not necessarily flow down to the details.

The 2-way EDI recommendation says that 997 functional acknowledgment transactions should be used to validate each EDI transmission. None of the OEM or first tier participants use this transaction in normal operations. All are capable of generating the transaction, but only do so as needed during testing. During implementation, the project team determined that use of the 997 transaction is not required as part of the 2-way EDI recommendation.

The 2-way EDI recommendation also states that 862 daily shipping schedules should be used to identify deviations from the 830 production release and authorize shipment. In fact, there are several methods being used instead of the 862. These methods include production broadcasts, Faxed authorization to ship, updated 830 transactions, and kanban pull tickets. During implementation, the project team determined that use of the 862 was not appropriate for all businesses and not required as part of the 2-way EDI recommendation.

4.2.6 Data Collection in pilot firms

Issues

As described in the *Initial Evaluation Report* and the *Improvement Criteria, Domains and Metrics Report,* the initial period of metrics collection gave rise to the following issues (see reports for more detail):

- Difficulty in understanding how to properly track certain metrics.
- Problems with interpretation. Companies often "understand" but interpret and measure the same metrics in different manners.
- Existing systems are often not able to generate MAP metrics data with ease.
- Inaccurate internal data. For example, one company is unable to provide data pertaining to inventory levels because of a highly inaccurate inventory management system.

- Difficulty in providing historical data. For example, no historical data on inventory or sales levels by part number.
- No one directly responsible for the gathering and reporting of data.
- Confidentiality: certain companies were reluctant to divulge financial data.
- Difficulty in starting the process of gathering and submitting data.

These issues were tackled through repeated contact and training of the participating companies. As the implementation phase of MAP drew to a close and the final phase of collecting and analyzing data began, the majority of the issues had been solved, however the following issues persisted:

- Companies regularly submitted tardy data, sometimes several months late.
- Some companies remained unable to collect data on certain metrics.
- Questionable validity of certain data.
- Confidentiality: certain companies refused to divulge a) any data, b) certain financial data.
- MAP project metrics data was gathered for a subset of parts. This caused the process of gathering data to be highly labor intensive at plants who did not possess flexible information systems. As a result, metrics collection and submission was viewed by many as a time-consuming chore that often fell to the bottom of a material manager's 'to do' list.

The persistence of these issues led to several important lessons learned relevant to future projects.

Lesson I: The Pilot company executives and project staff must be highly committed to the metrics effort.

Companies who participate in a pilot are primarily concerned with the running of their day-to-day business. Realistically, the task of gathering metrics data will not be a top concern of plant staff *unless* it is made a top concern through clear-cut executive commitment.

Lesson 2: Address confidentiality issues at the outset of the project

The sample size of a pilot project is small to begin with. The smaller the sample size, the more difficult it is to make statements with high confidence levels about trends in the data. In the MAP project, Milliken and Company refused to submit any metrics data, and several other companies chose to submit only selected data out of concerns for confidentiality. In hindsight, it was a mistake to fail to anticipate this problem at the project's outset. Had the issue been addressed in advance, it would have been possible to recruit a pilot chain committed to submitting data. In other words, pilot companies executives should be required to make an up front commitment to submit metrics data in return for the benefits they will receive through pilot project participation.

Lesson 3: Establish metrics and begin data collection as early as realistically possible.

The metrics effort should begin as early as realistically possible. In order to accurately measure the before and after effects of implementation activities, a long term time series is needed. The MAP project attempted to gather sixteen months of metrics data from participating companies. However, the project team finalized its six metrics during the summer of 1995 and did not begin aggressively pursuing the submission of metrics data until September 1995. The assumption was that companies would be able to provide historical data, dating back to February 1995 with little effort. This proved to be a faulty assumption. Many companies were unable to provide historical data due to limitations in their existing systems. Some companies were able to provide partial data, however of varying degrees of use. Only a few companies were able to provide extensive and useful historical data. Had the metrics been established earlier, the collection process could have begun earlier and this problem could have been avoided. Thus, in order to assure a long-term sample of data, it is essential to decide upon and begin collection of metrics as early as possible.

Lesson 4: The metrics effort must be highly structured to ensure validity of data

In order to assure the integrity of pilot project metrics data, the effort must be highly structured. Nothing should be left to chance. It is important to remember that pilot companies are concerned mainly with running their business and responding to the daily pressures and crises. The experience of MAP suggests that project teams should be prepared to go to extremes when training pilot companies in the metrics. The more structure, consistency, and predictability in the process of collecting and submitting metrics from firm to firm, the more reliable the metrics and ensuing analysis.

It may be necessary to go to certain companies every month for several months to help the project manager prepare his/her metrics data. By sitting shoulder-to-shoulder with the project manager and walking him/her repeatedly through the process of gathering information, the quality of the data is insured.

Lesson 5: Tardy data should be avoided if possible. Habits form.

Tardy data limits the project team's ability to provide regular meaningful analysis and updates. More importantly, the validity of data is more difficult to ascertain when it is tardy. The more time that separates an event and the reporting of the quantitative impact of that event (i.e., a schedule change leads to spending on premium freight), the less likely it is that plant personnel will have an accurate memory of causality. The MAP experience demonstrates that bad habits can form quickly. Once a company gets in the habit of submitting late data, that habit is hard to break. Future pilots would be well advised to pay special attention to this point.

4.2.7 Impediments to Change

During implementation, the project team identified some recurring issues that limit a companies ability to change and therefore limit the impact within the supply chain. These issues include the following:

- Existing MIS systems limit change. Existing business computer systems limit the integration of new information technologies and inhibit change in business practices.
- Even if supply chain impact is big, recommended changes may not be most important tasks for each participant.
- Suppliers are constrained by limited financial and staff resources; solutions must be low-cost and have minimal impact on staff time.

Changes in information flow between companies and changes in business practices naturally intersect with the functions of a company's internal information system. Information systems are big and widespread within the organization. Information systems are difficult to change. Changes are expensive and risky because they touch all functional areas. As a result, change and responsiveness is limited. For example, it is difficult, and therefore unlikely, to modify information systems to identify large changes in production requirements from suppliers so they can be notified.

The recommendations developed for MAP are intended to improve the performance of the supply chain as a system. Adopting the changes entails expending resources at the company. Much of the benefit of those changes go to their customer.[2] Currently, there is not a strong cost justification for making these changes.[3] Resources to implement MAP recommendations must compete with a host of improvements that company executives would like to take on. Implementation of MAP recommendations have been limited by company priorities which often favor improvements to internal operations.

For small and medium-size suppliers, the absolute cost of implementation has limited adoption. For example, Rockford Spring understands the benefit of external e-mail that is integrated into their internal e-mail system. The $6,000 cost of the Gateway software is preventing adoption. While a stand alone external e-mail solution will meet that basic intent of the MAP recommendation, Rockford staff will not have an

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[2] The exception is EDI integration which promises increased productivity within the firm.

[3] It is a primary objective of the MAP project to develop a sound business case that justifies adoption of the MAP recommendations.

open access to their trading partners as is possible. For small suppliers, cash outlays and staff time are often limited. Where possible, low cost alternatives have been implemented. It was better to implement a minimal system than to not have a system at all.

4.2.8 Assistance to Change

During implementation, we found that the business structures of the participating companies were similar. This similarity allowed the use of common templates for implementation of technologies and business practices.

Tools were useful during implementation. Checklists were used to collect as-is information in a common format. The EDI Test Bed was useful for testing and debugging e-mail and EDI communications. When a company installed a new e-mail or EDI capability, that system was tested using the EDI Test Bed prior to pilot testing with their trading partner. By using the Test Bed, companies were able to validate their communications capability with a "known good" site. This avoided the problem that can happen when both ends of a communications link are bringing up new systems. If there is a problem, it is often difficult to identify who is at fault. The Test Bed also allowed systems to be debugged without disturbing customers. Fewer interactions with the Test Bed were required to establish the new communications capabilities at the participating companies, than was expected.

It was necessary during implementation to continue to "sell" the MAP recommendations at various levels in the participating companies. The project has been going on for over a year and participants needed to be reminded of the overall objective and the individual benefits. Company management valued hearing that it was important to their customers. Technical staff appreciated seeing documentation about how the new systems will integrate into existing operations.

4.2.9 Managing and Conducting Pilots

Electronic Commerce (EC) supply chain pilot projects are intended to leverage EC technologies to accelerate the adoption of new inter-firm business processes. Pilot projects cannot be successful by implementing technologies in a vacuum. Technology should be used as an effecter that results in improvement in efficiency and staff skills when applied in concert with business process modification and organizational change. Outcomes of a pilot project are a business case and implementation guidelines for the change. This section outlines four major steps that encompass the essence of a pilot. These steps are followed by the underlying principles for a successful pilot.

Establish Pilot Context, Scope, and Goals

Develop Focus for Pilot

Identify an inter-firm business process that can be improved by leveraging EC technologies, organizational changes and business process modifications.

Frame Goals within the Context of the Pilot

Make sure that the pilot has clear goals and objectives. Be precise to avoid confusion during the pilot. If the pilot objectives can not be conveyed to potential participants, the goals are not specific or are not meaningful to the candidate firms. The goals of the pilot must have a business impact in the real world. If achieving the objectives will not improve the participating firms' businesses, there will be little enthusiasm for the project.

Make sure that the pilot goals can be achieved from a technical and business practice perspective. If the goals are viewed as impossible to achieve, finding willing participants will be difficult. Establish time frames that can be realized. Remember that participating firms have a business to run during the life of the project. Expect delays due to changes in individual firm's business conditions.

Establish Coherent Core of Pilot

When possible, start with an industry association that can act as a forum for the team to assess the current situation and reach consensus on new approaches. Alternatively, a large firm can organize pilots among its suppliers if they are willing to act as a facilitator for improvements across their supply base.

Recruit industry champions and obtain buy-in to the pilot focus and processes. The champion must believe in the pilot and become its spokesperson. A true champion can draw support for participation across an entire industry and throughout specific supply chains. The champion must strongly promote deployment of successful pilot results.

Collect Appropriate Best-Practices from All Industry Sectors

Find and document world class best practices and benchmark performance levels, regardless of the industry sector, that are applicable to the focus of the pilot. These will be the prime candidates for implementation during the pilot.

Develop Support Infrastructure for Pilot

Develop an understanding of the role of supply chain participants, industry associations, vendors, and outside consultants to insure operational cohesiveness during pilot execution.

Arrange for funds for assessment, intervention design and execution, evaluation, and tool building. Establish proper resource levels to accomplish the pilot objectives. Make sure requirement levels for staff and money are sufficient to achieve the pilot's goals.

Establish outside resources to assist firms that will not have expertise to meet pilot objectives. Many potential participants will not have all of the necessary technical or business skills to meet the pilot's goals. Technical and business experts should be available to provide the required support.

Define Pilot and Participants

Recruit Firms to Participate in Pilot

Select an individual product or component from the industry core that provides an environment conducive to improvement for the desired pilot intervention process. Complexity should be minimized to allow concentration on the pilot objectives. Supply chain(s) should be selected that encompass all representative manufacturers involved in the production of the selected product. No more than two or three supply chains should be utilized in the pilot.

Recruit firms for which the pilot will resolve a real business issue either by solving an existing problem, improving business practices, or by allowing the companies to move into new areas of technology.

Sell the potential improvements to business practices and procedures that are made possible by taking part in the pilot. Establish a competitive advantage, even if it is short-term, for the participating firms. Be honest about the effort required for the pilot. Participating firms must understand the level of commitment for staff and money necessary to properly achieve the pilot goals. There will be times when internal commitments conflict with scheduled pilot activities. Some of these situations will be known at the beginning of the project, while many will arise during the pilot due to new business commitments.

Sell management on involvement. Management must buy into the pilot as part of the sign-up process. Approval by technical and business staff alone will result in major conflicts later in the project when pilot objectives clash with management's internal business needs.

Establish Pilot Working Group Membership

Membership of the working group is comprised of both technical and business staff personnel from each participating firm. This group must have a regular meeting schedule. As the group is established it should provide a reporting mechanism to review progress during the pilot. The group must set up a means for rapid communication for problem resolution and routine information exchange.

This group reviews the objectives and reasons for the pilot and confirms pilot schedules and resource requirements. Early in the pilot it must set up roles and responsibilities for pilot execution. This group also establishes the next level of detail for pilot activities and plans, including the schedules.

Members of this group must have access to their corporate management to insure a constant flow of information concerning the pilot into each participating firm.

Develop Metrics to Measure Impact of EC Implementations

Metrics are measurements of business data that will be impacted by the implementation of the pilot's technology and business practices. The initial set of metrics should reflect improvements within a firm. The metrics must be collectable by the individual firms. If a firm cannot gather the required data, the metric should be dropped.

Early in the project, the Pilot Working Group should review the recommended metrics, make any additions required, and then approve the set of metrics for use in the pilot. This procedure establishes a better understanding of the metric process and provides a higher level of ownership by the participants.

At the beginning of the pilot formal baseline data should be collected from each firm. The results of the benchmarking are used as inputs for planning during the execution phase of the pilot.

Execute Pilot

Develop As-Is and To-Be Models

Develop formal As-Is scenarios for current business processes that fall within the pilot's scope and To-Be models for the modified business processes. These models are detailed to the level that all inputs, process, constraints, and outputs are well defined. This process is time consuming but necessary for a successful pilot.

Develop Individual Firm Plans to Support Overall Project Objectives

Develop written formal plans for each participating firm. Plans must include technical implementations and business process changes required to meet the pilot's objectives. Detail tasks should be developed and include who is responsible to accomplish the task, how much effort will be required, and when the task must be complete. During this process, technology products are evaluated for implementation and final selections made.

Approval from internal management must be obtained to insure the success of the pilot. This should be accomplished by a formal review with all necessary management in attendance. After approval, management must be updated on a regular basis both by internal staff and overall pilot management.

Plans are living documents. As such, they must be updated to reflect all modifications made as the pilot proceeds.

Implement Technology and Business Process Plans

During this activity the selected technology products are installed and the accompanying business process changes are implemented. Testing of internal functionality is performed, followed by testing with external pilot partners as required. This activity includes training users in the new technologies and business practices. Once all of the tasks are completed the pilot technologies and business practices are moved into daily use.

Evaluate Implementation Impact

Metrics must be collected on a regular schedule. Each participating firm must provide the metric data on a well established schedule. Past pilots have shown that a monthly schedule is the best interval for collection. This allows companies to build a regular procedure for providing this data. The longer the interval between reporting times, the more likely it is that companies will provide less meaningful data or lose data completely.

Metric collection procedures, metric data format, and reporting methodology should be tailored for an individual firm when possible. If one company can provide a computer printout with the required data while another has a management report containing the same information, either should be accepted.

Whenever possible, collect any metric data available for the period immediately prior to the pilot. Data from three to six months prior to the pilot will provide a longer baseline to use for comparison purposes.

As part of the evaluation, a case study for implementing pilot objectives is developed at the individual firm level. The metric data from the firm is analyzed. This is combined with anecdotal implementation information from post-mortem interviews with each firm. A post implementation benchmarking data collection is performed as a final verification of the impact of the pilot objectives.

Deploy Pilot Findings

Publish Implementation Guidelines for Broad-Scale Deployment

A formal reporting of the outcome of the pilot is published. This includes guidelines for implementing the final pilot findings if warranted. A pilot may lead to the finding that the objectives are not achievable at that time and as a result no deployment would take place. If the pilot was successful in building the case for deployment, these guidelines should be targeted to as broad a scale as is possible. This maximizes the impact of the pilot program.

Develop Deployment Activities

Deployment activities include a wide variety of functions. Chief among these are formal support for the findings of the pilot from all participants by announcing adoption within their own firms and requesting compliance from business partners. Individual companies should develop formal policies for implementation. Trade associations within the business sector should develop formal awareness seminars, descriptive business practices for implementing the pilot's objectives, and detailed training sessions on how to implement the findings. Programs should be established to make appropriate commercial vendors aware of the pilot's findings. These vendors should be encouraged to incorporate the technologies and methodologies into their products.

Ensuring Executive Level Commitment and Choice of Project Manager

One of the most common causes of failure in reengineering projects is the lack of executive level commitment. The MAP project experience is consistent with this general trend. In the MAP companies that made the greatest strides, there was clear buy-in and sponsorship at an executive level. It is reasonable to state that of the companies who did not fully adopt MAP project recommendations, a common cause was the lack of high level buy-in and commitment. It was not unusual in such cases to have a project manager and/or plant workers highly committed to the vision of project recommended practices. However, without appropriate power and authorization, these workers were often unable to implement change.

This leads to a related point. As important as executive level commitment is the selection of the project manager. A powerless project manager limits the extent to which change can be made.

In some cases, the project team was able to identify additional players in the pilot companies whose efforts helped affect change. In others, the combination of a powerless project manager and the lack of executive level commitment limited the project team's ability to facilitate change in the pilot company.

Effects of Long-term Nature of Project

The MAP project spanned a period of two and a half years. As time moves on, players change and executives and pilot companies tend to 'lose attention.' For these reasons, continual education and re-education efforts are vital to ensuring project success. The MAP project team attempted to retain the commitment and energy of pilot companies by holding executive reviews at the Chicago area companies in October '95 and an executive dinner and briefing in Detroit in November 1995. These events achieved their desired effect. However, it would have been advantageous to have scheduled more such events. Such events serve to remind and re-educate executives and project team members the objectives of the project. More importantly, these events provide executives with a sense of *progress*, the understanding and belief that something is happening. Without such events, the team is entirely reliant on the tenacity of individual

project managers at participating companies to dutifully bring this news to the executives. Some do, some do not. Without a conscious focus on regular reporting to executives and reinforcement of project goals, it is easy for the executives to conclude that nothing is happening and lose commitment to the project.

Impact of Unforeseen Events

As the MAP project progressed, certain companies limited their involvement in the project and two companies dropped out, for reasons unforeseen at the outset of the project.

In spring of 1995 Textileather stopped all project activities, no reason was given. In the spring of 1996 Milliken, who had been an active participant in the early phases of MAP ceased project involvement. This was unfortunate, for Milliken personnel had helped create the MAP project metrics and had spoken enthusiastically at Autotech '95 about how EDI and process changes had led to significant cost savings.

The purchase of a participating company can affect the pilot project. Atwood Automotive, a second tier seat track supplier, was purchased in April 1996. Shortly thereafter, all MAP-related activities and submission of metrics data ceased as the new owner focused resources on internal priorities and, furthermore, replaced project personnel with new employees. From the project's point of view, this situation was unfortunate, for Atwood was a key link in the MAP chain as the only second tier hardware supplier. Atwood's lead times of over one week constituted an increasingly significant share of supply chain lead time.

As detailed in the *Initial Evaluation Report*, Atwood had originally committed to a highly limited involvement in the MAP project due to the severity of internal fire-fighting and lack of high level commitment to the project. Under the assumption that the "right" people at Atwood simply did not know of, or understand the benefits of the MAP project, the project team made a concerted effort to identify a high level manager who could function as an internal champion of the MAP project. Contact was made with the vice president of manufacturing, a key player who had been entirely unaware of the MAP project due to breakdown of Atwood internal channels of communication. With this player's assistance, the team substantially increased Atwood's involvement in the project." Consultants from Wizdom Systems spent one week with Atwood personnel, conducting a detailed 'As-Is' analysis of the Stockton plant's operations. Later, a weekend strategic planning workshop was held—attended by the plant manager and the vice president of manufacturing who worked with plant personnel to put together a plan for improvement consistent with MAP recommendations. At this time, Atwood began submitting metrics data for the first time. These developments were highly significant because of Atwood's position and impact in the MAP chain. When the company was purchased by new owners and all previously-made plans were abandoned, MAP was never able to help Atwood reduce lead time within the time frame of the project. Similarly, MAP was unable to help Atwood pass full planning horizons to its suppliers. These two improvements would have been significant. It is important to note that the new owner is sophisticated with EDI and it is expected that there will be significant improvement at the former Atwood plants. However, these improvements will occur after the closure of the MAP project.

4.2.10 Electronic Commerce Technology Adoption

Technology should be used as the effecter for business process changes to produce improvements in efficiency both internally within an individual firm and between trading partners in a supply chain.

The introduction of a new technology such as e-mail or EDI without modifying the associated business practices and/or procedures may create some minor improvements. However, it is just as likely to cause decreases in efficiency and introduce delays in moving information through the supply chain. This latter case was established early in the project when the use of e-mail was attempted to coordinate information flow. Inconsistent levels of e-mail technology implementation resulted in delays of correspondence where one group assumed that e-mail was being read in a timely manner and other groups would not reading e-mail in such a fashion. This would not become apparent until subsequent conversations indicated that this was not the case and important information had been missed. The main cause of this problem was that those firms that did cause the delays did not incorporate e-mail into their business practices and procedures.

Technology must be integrated into business systems and practices for the implementation to be successful. The integration of new technologies into a firm's business systems yields the greatest level of benefit both from an efficiency and financial point of view. The firms that integrated EDI into their systems all reported

considerable savings of time and subsequent dollars in processing the information flowing through the supply chain. Those firms that did not integrate EDI, while not receiving any immediate benefits, also saw the potential and made decisions to integrate their business systems as soon as their software vendors release the EDI integration modules required for the effort. In the case of EDI, without integration, EDI is the most expensive facsimile machine in the world.

Mandating change from a higher level within a supply chain is more effective when the higher level members work with the subsequent levels to communicate the needs and benefits to all members of the chain. One of the major successes of the MAP project was the benefit all participants received from the implementation of EDI. Every participating firm stated that the main reason for this success was the communication by the OEMs and Johnson Controls with the lower levels during the implementation. There was no explicit "big stick" statements from the higher levels in the chain. Instead, project meetings and detailed implementation meetings were held with all firms participating to insure the reasons for actions were understood and all parties' concerns were addressed whenever possible.

Increasing the speed with which information moves down the supply chain can assist lower level suppliers in becoming more efficient in handling customers requests. The receiving customer of information in a more timely manner allowed lower level suppliers to make adjustments to their manufacturing schedules to better control inventory levels. As a result of this change several firms were able to increase inventory turn rates and decrease the cost of "Just-In-Case" inventory levels.

Lower levels within the chain, regardless of size, have important input to the process of supply chain improvement. This lesson is somewhat similar to the one just listed above. The main difference is the emphasis as to where the information originated from within the chain. The upper levels of the chain were genuinely surprised at the actions required by the lower tiers to compensate for what appeared to be minor variations, from the higher level's view, in schedules and/or quantity changes. Once these problems became apparent, the higher levels committed to researching what could be done to minimize theses variations. This study of schedule variation will be a major follow-on activity for some of the MAP participants.

Technology must be disseminated widely to the appropriate users to be effective. In the case of e-mail, several firms opted to have a single interface point to receive all e-mail coming into the firm. E-mail would then be printed and distributed to the proper recipient. Subsequent replies would have to be given to the interface point for transmission. In no case was this scenario successfully used during the project. In all firms where this implementation was tried, e-mail quickly fell into disuse and as a result was not used for any critical communications throughout the entire supply chain.

Planning by cross-functional teams within the various companies provided the greatest benefits and results. Development of the plans for implementing e-mail and EDI were accomplish best when representatives of all impacted departments within a company were involved in planning process as early as possible. Several firms started by just involving their purchasing group or their information systems departments. Proper planning did not get started at these firms until the case was made by the MAP project team that all impacted areas had to be involved in the plan development activity. The lack of information system's participation was spotty at one firm throughout the project. This resulted in constant plan revisions and led to no real impact or improvement within this firm. Fortunately, this firm was at the end of the physical supply chain and their lack of improvement did not impact the overall project significantly.

Cost effective solutions exist for all levels in the supply chain regardless of the size of the firm. Common "wisdom" has long stated that small firms cannot implement EDI in an economical fashion that has any justification other than that it was required by a customer. The case of R-R Spring, the smallest MAP participant, disproved this notion. By implementing EDI and integrating it with their manufacturing software, a real ROI was achieved on their financial investment. If a firm of less than 40 people with an annual revenue of $4 million can realize true savings, then just about any firm can achieve some type of positive financial gain by implementing EDI.

Management awareness during the planning process must be maintained to insure final approval for implementation. During the planning process in all firms except one, management was constantly updated on the status of the MAP-related activities and how they would impact operations within the company. In those firms that did update management, the formal management reviews of the plans were mere formalities and approval was given for implementation in all cases. In the one case where management was

not adequately involved, or at least aware of the major impacts, approval was not achieved during the management review. As a result, the project had little impact on this company's activities and few gains in efficiency were achieved. This case demonstrated the importance of obtaining early management buy-in when introducing change into an organization.

Smaller firms are more agile in adopting new technologies once decisions are made on the technical and procedural aspects of implementation. There was a direct correlation between the size of a firm and the time required to implement EDI. The smallest firms, who had no EDI prior to the project, were able to actual implement EDI in less than three months once their plans were finalized. The larger firms had more organizational issues and even though they were all EDI capable, took longer to make the necessary changes for the MAP activities. Often the smaller firms got "ahead" of the larger firms higher up the supply chain and seemed to be "waiting" on the other firms to make their modifications.

Small firms are not use to the detailed planning exercises required to properly implement new technologies and the associated business process changes. One of the major problems for smaller firms was their inexperience with developing detailed plans to implement objectives. Early in the project the technical support team was constantly asked by the small firms to "just tell us what we need to buy so we can get it." Initially there was little appetite for expending the time and effort to develop detailed "As-Is" models of current business processes or formal "To-Be" models for the new procedures. As the companies saw that this activity did lead to a better understanding of their businesses, they became more active in the process. In fact one firm, upon seeing what their existing order entry process actually looked like when formally put on paper, immediately saw that they could make a sizable gain in efficiency by redoing the process even without any technological enhancement. As a result they restructured this process long before any technical changes were made.

Small firms are technically aware but lack the time and technical expertise for detailed research on how the technologies will impact their businesses and which implementation is best suited for their environment. This is one area where smaller firms are at a distinct disadvantage to large firms. Larger firms tend to have in-house information staffs and dedicated purchase groups. This often allows the large firm to develop a level of expertise and specialization that does not exist in the smallest firms. In the small companies, individuals where many hats and perform a variety of duties. As a result, these staff members do not have the detailed knowledge concerning these functions. Nor do they have the time to investigate alternate technical scenarios and look at different models of process implementation. During the MAP project the technical support team filled in this gap. The importance of this assistance cannot be overlooked and must become part of the supplier development programs of the larger firms at the higher levels of the supply chain.

4.2.11 Business Process Reengineering

The team recognized from the outset of the MAP project that in order to improve the flow of material information and material within the pilot supply chain, technology alone could not provide the full solution. Business processes would have to be analyzed and re-designed. In the end, the findings of the MAP project demonstrate that the most significant gains were achieved through the streamlining and reengineering of business processes, *not* from the mere implementation of technology.

The MAP project represents a unique effort to conduct Business Process Reengineering at the level of the supply chain. In phase I, the project team constructed Integrated Definition (IDEF) models of each company in the MAP supply chain. The individual company models were then integrated together to create an extended enterprise reference model. The project team's list of nine recommendations were created from the analysis conducted in this phase of the project.

In order to reengineer the supply chain, it is necessary to implement process improvements in key processes within the companies in the chain as well as reengineer the inter-company processes.

Summary of process change methodology

Process improvements were designed and implemented in accordance with the following methodology:

1. Conduct Detailed "AS-IS" Process Analysis
2. Develop Benchmark "TO-BE" Process Model
3. Determine Variances from "TO-BE" Process Model
4. Determine Business Process Improvement (BPI) Tasks
5. Implementation Support and Training
6. Identify Continuous Improvement Needs

A more detailed explanation of each step follows.

Conduct Detailed "AS-IS" Process Analysis

Supplementing phase I's IDEF models and knowledge gathered during previous site visits to participating companies, AIAG observers created process flow models of each company's EDI and e-mail processes. The models track the information flow of the 830 material release and the information contained in the 830 through each company. Key areas of "impact" were documented, including: who handles the information, who is impacted by what information, and when the impact is registered. The process of creating flow models through structured observation is extremely expeditious and appropriate for smaller technological implementations.

The analysis is divided into three components: 830 receipt, internal processing of 830 information, and sending of the 830 material releases. Data pertaining to impact areas is to be recorded on the Process Observation Checksheet, see appendix.

Model validation:

After each AS-IS flow model is created, the AIAG team validated the model with the company I implementation team. This served as a "quality verification" to make sure the sample data does not reflect an extreme data, such as the timing of information etc.

Develop Benchmark "TO-BE" Process Model

The benchmark "TO-BE" process model will describe a generic, ideal set of processes for a fully integrated EDI system. The AIAG team will utilize this model in creating the "TO-BE" process improvements for each company. The team has created a draft version of the benchmark "TO-BE" Process Model based upon available resources and a site visit to JCI's Orangeville plant on 10/16/95. The team plans to conduct a limited number of site visits to successfully integrate EDI sites, not necessarily limited to the automobile industry, and complete a literature review in order to complete the benchmark model.

Determine Variances from Benchmark "TO-BE" Model

The AIAG team will examine and document individual company variances from the Benchmark "TO-BE" Model. These variances will indicate areas for process improvement. Because each company faces a different set of technical and systemic circumstances, the Benchmark "TO-BE" model can not be simply implemented in every setting. Rather, the model will serve as a directional guide for process changes and an indicator of future continuous improvement plans.

Determine Business Process Improvement (BPI) Tasks

The process improvement plan will be developed in consideration of the technological implementation plan as well as the state of existing internal manufacturing information systems.

The plans will be communicated in a two-stage process. Initially, the AIAG team will send the plan by fax to the company E-mail/EDI implementation team and gather feedback by telephone. As necessary, the

finalized plans will be presented to each company during a site visit. Once changes have been proposed to a company, the implementation team will accept or decline the recommended process changes. If accepted, the process change should be immediately executed or piloted.

Implementation Support and Training

Develop documentation

The AIAG team worked with company personnel to develop materials necessary to document the process changes for each company and to spell out the new protocol for execution of tasks. These procedures included, but are not limited to: Data Archiving, Systems Testing and Maintenance, Data Back-Up, and Sending and Receiving Data Transmissions.

Develop Test/ Disaster Contingency Plan

Procedures were developed as needed to maintain critical business processes when failures occur in the internal and/or external E-mail system.

Implementation Support

Following implementation, the AIAG team provided assistance to complement technical support activities based upon the implementation plan. The change management support included the commencement of newly redesigned processes, the determination of workload imbalances, and the adjustment to new work routines.

Identify Continuous Improvement Needs

Track Project Progress

The team created methods to identify and implement continuous improvements in the EDI system..

Follow-on Observation

An assessment of the new work procedures was typically performed several weeks after their implementation. The team provided additional implementation support to MAP companies as needed.

4.2.12 Managing Change and Project Management

The implementation phase demonstrated the importance of buy-in and commitment at each company. The world is full of good ideas that are not implemented because key players feel no ownership of the plan. With this in mind, the project team created buy in at each company by involving each company's project manager in the creation of the company implementation plans for EDI, e-mail, and integrated EDI. By doing so, the plans were viewed as *company* plans as opposed to externally created suggestions by the individuals responsible for implementing the plans. To further bolster support for the plans, management review meetings were held at the five Rockford area firms to secure high level management commitment and increase awareness. For the most part, participating companies displayed a level of engagement and participation in the MAP project.

A small subset of companies, however, did not display the required level of commitment. These cases further demonstrated the importance of an internal champion. For example, Atwood Industries, as a second-tier seat track supplier represents an important link in the supply chain. Due to internal business situations, Atwood personnel felt overwhelmed by their day-to-day work and could not commit to full implementation of the MAP project recommendations. The company was preoccupied with putting out fires. Ironically, the MAP project offered a mechanism for eliminating or reducing the root causes of several of these fires. In the summer of 1995, the team was able to secure a commitment from Atwood to pass the 830 material release with the full OEM planning horizon down to its suppliers. Although this insured that the supply chain would possess an unbroken EDI chain, the company could not commit to making process changes internally or with suppliers and customers, or providing important metrics data. Under the assumption that the "right" people at Atwood simply did not know of or understand the benefits of the MAP project, the project team

made a concerted effort to identify a high level manager who could function as an internal champion of the MAP project. Contact was made with the vice president of manufacturing, a key player who had been entirely unaware of the MAP project due to breakdown of Atwood internal channels of communication. With this player's assistance, the team is currently in the process of increasing Atwood's involvement in the project.

4.2.13 Benchmark vs. Typical Case: Impact of Internal Business Processes

The participating companies range from the OEMs and their first tier suppliers who operate on a Just In Time (JIT) and Sequenced Part Delivery (SPD) to small, hardware manufacturers who depend largely upon manual systems, maintain large inventories, and regularly ship late to customers. Generally, the upper tier companies entered into the MAP project with EDI already implemented and efficient internal business processes. Information comes in, is exploded into supplier part numbers as it passes through internal business systems, and is passed down to suppliers with little to no distortion of the original data. Such companies offered, to varying extents, a benchmark case of EDI implementation. The "typical case" is distinguished by less efficient internal processes and the distortion of data as it passes from tier to tier. In implementing the MAP project recommendations at such companies, it is necessary to look beyond the simple question of "does this company possess fully integrated EDI?" and additionally analyze the quality of internal business systems that can contribute to the passing of faulty or delayed data through the supply chain. Such factors include, but are not limited to, accuracy of inventory systems and accuracy of bill of material. Flaws in the outputs of these systems to the need for redesigned internal processes.

4.2.14 Collection of Metrics Data

Participating companies are currently collecting and submitting metrics data that will be used to quantify the effects of implementing the project's nine recommendations on the supply chain. Despite time spent during the metric development period, several common issues arose while gearing up the process of collecting thorough and accurate supply chain data. Most noticeably, companies were slow to begin the process of submitting metrics data. Companies generally encountered the following problems when attempting to gather the data.

- Difficulty in understanding how to properly track certain metrics.
- Problems with interpretation. Companies often "understand" but interpret and measure the same metrics in different manners.
- Existing systems often not able to generate MAP metrics data with ease.
- Inaccurate internal data. For example, one company is unable to provide data pertaining to inventory levels to because of a highly inaccurate inventory management system.
- Difficulty in providing historical data. For example, no historical data on inventory or sales levels by part number.
- No one directly responsible for the gathering and reporting of data.
- Confidentiality: certain companies were reluctant to divulge financial data.
- Difficulty in starting the process of gathering and submitting data.

In order to insure the integrity of supply chain statistics, it is important that each metric be understood and recorded consistently from company to company. The project team achieved this goal by providing training and clarification of the measurements as needed to participating companies. In the case of certain metrics, new information led to a rethinking and occasional refining of the original metric's formulation. It became clear that the development of stable metrics is an iterative, communication intensive process.

4.3 Case Studies

This section presents brief case studies of four MAP companies. Implementation activities are outlined along with an indication of the results of these activities. The state of each company with respect to EDI

capability and Internal Process Efficiency (measured by information flow lead time) at the outset and conclusion of the MAP project is represented in matrix form in the diagram below.

To maintain the confidentiality of MAP company internal operations, a general portrayal of each company's situation is presented. We present case studies of three third tier hardware companies and one second tier hardware company. Reference the *Initial Evaluation Report* for more information on the nature of the implementations and related issues at remaining MAP companies.

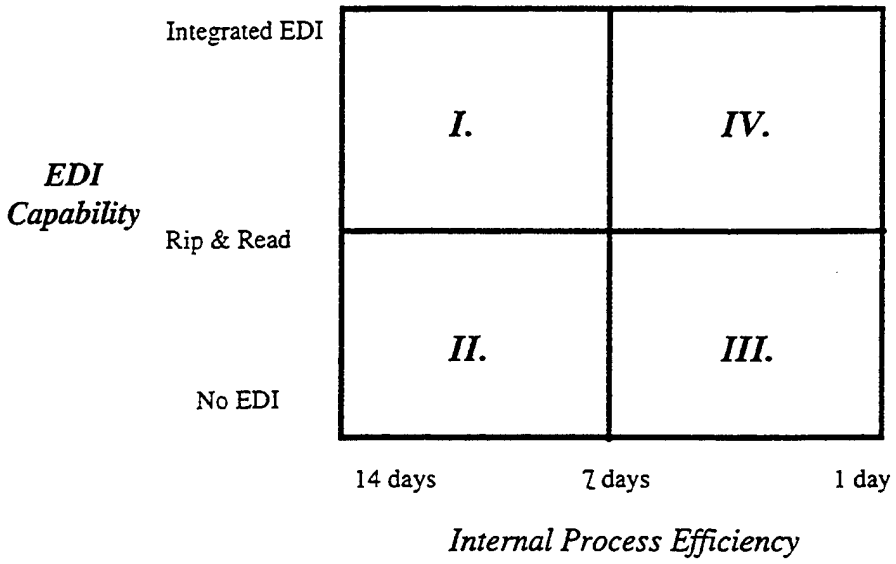

Figure 4-15. General Improvement Matrix

Below is a description of the quadrants of Figure 4-15. General Improvement Matrix.

Quadrant	Characteristics
Quadrant I	Integrated EDI, Low Internal Process Efficiency • Poor use of information systems • Antiquated information systems • Excessive non-value added activities
Quadrant II	No EDI, Low Internal Process Efficiency • Exclusive reliance on manual processes • Re-keying of data, high error rates • Excessive non-value added activities
Quadrant III	No EDI/Rip 'n Read EDI, High Internal Process Efficiency • Re-keying of data, high error rates • Streamlined business processes, few non-value added activities.

Quadrant	Characteristics
Quadrant IV	Integrated EDI/ High Internal Process Efficiency • Benchmark case = 1 day cycle time • No re-keying of data, low error rates • Benchmark case = few non-value added activities

4.3.1 R-R Spring

Tier: Three (Hardware)
MAP Product: Springs
Location: Franklin Park, IL

To implement EDI, R-R Spring took the following actions:

- Obtain and install EDI translation software
- Obtain Value Added Network services
- Modify business processes for electronic receipt and transmission of information
- Test and pilot EDI data exchange
- Production EDI with customers

To integrate EDI, R-R Spring did the following:

- Obtain and install EDI to business application interface software
- Upgrade computer hardware
- Test integrated systems*
- Production use of integrated EDI and business applications*

* Note: Due to delays from its MIS provider, R-R Spring has not yet completed integration of EDI. It is scheduled to occur in the short term future.

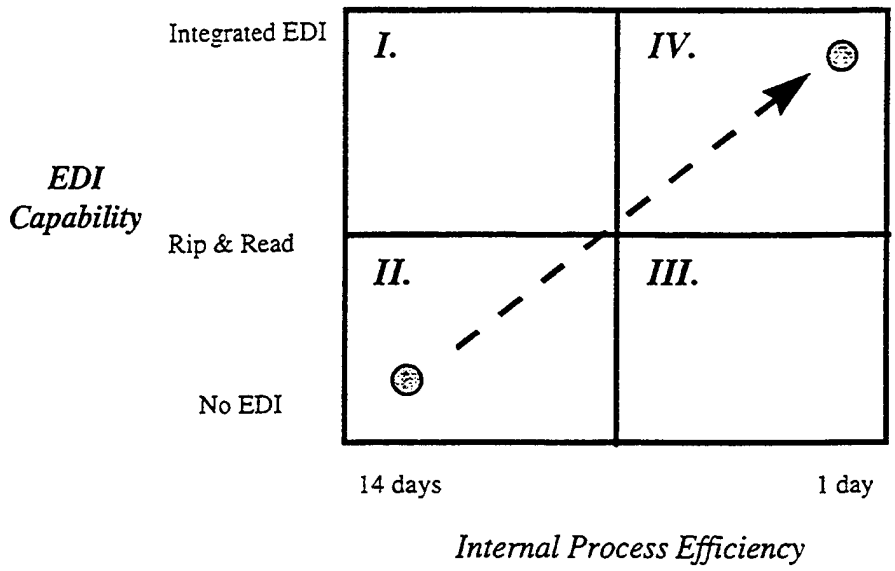

Figure 4-16. R-R Spring Improvement Matrix

By integrating EDI and improving its business processes, R-R Spring was able to make significant reductions in lead time:

> "We have reduced the cycle time of processing in an order in the office and the cycle time of producing an order for the shop. In sum we have reduced our whole lead time by about two weeks."- Rick Richter, R-R Spring

The additional time gained by speeding the flow of information through the front office has allowed R-R Spring to improve its ability to schedule production. This has yielded several favorable effects. Inventory turns for MAP parts has increased at R-R Spring since implementing technology and process changes. These changes have impacted R-R Spring's ability to generate new business in two ways, as exemplified in the following quotations. First, quicker lead times have reduced R-R Spring's order fulfillment cycle to four weeks.

> I think it has helped increase our business, because a lot of our competition is quoting maybe 8-12 weeks for delivery and we can do it in four. So that has helped tremendously.
> - Rick Richter, R-R Spring

In addition, the mere fact that R-R is EDI capable has led to new business:

> "We were in a meeting with a major customer with another spring company. When the question came down as to whether we were EDI capable, we were and they weren't. We got the business and they didn't."
>
> - Ron Richter, owner, R-R Spring

4.3.2 Atwood

Tier:	Two (Hardware)
MAP Product:	Seat track
Location:	Seat track manufacturing plant in Stockton, IL Corporate headquarters in Rockford, IL

Despite possessing integrated EDI at the start of the project, Atwood still took almost two weeks to move release data to its suppliers due to inefficient processes and an antiquated MIS. At the outset of the MAP project it took Atwood an average of twelve days to get a material release to its suppliers from the moment it

project it took Atwood an average of twelve days to get a material release to its suppliers from the moment it received the release from JCI. Atwood sent releases to its suppliers by mail, which added an unnecessary three days to tier two lead time. The first change that Atwood made was to begin faxing its supplier material releases, dropping three days off lead time. In the fall of 1995, Atwood began sending its releases by EDI to its suppliers. The release typically went out every Wednesday. Atwood personnel made an important observation that enabled a lead time reducing process change. Supplier material release information was always available on Monday, yet was not sent out until Wednesday because it was checked and double checked by various individuals. However, the release almost never changed during these two days. Atwood changed their process to send the release out on Monday, thus reducing lead time by another two days to seven days. The improvement made by Atwood during the MAP project can be represented in the following manner:

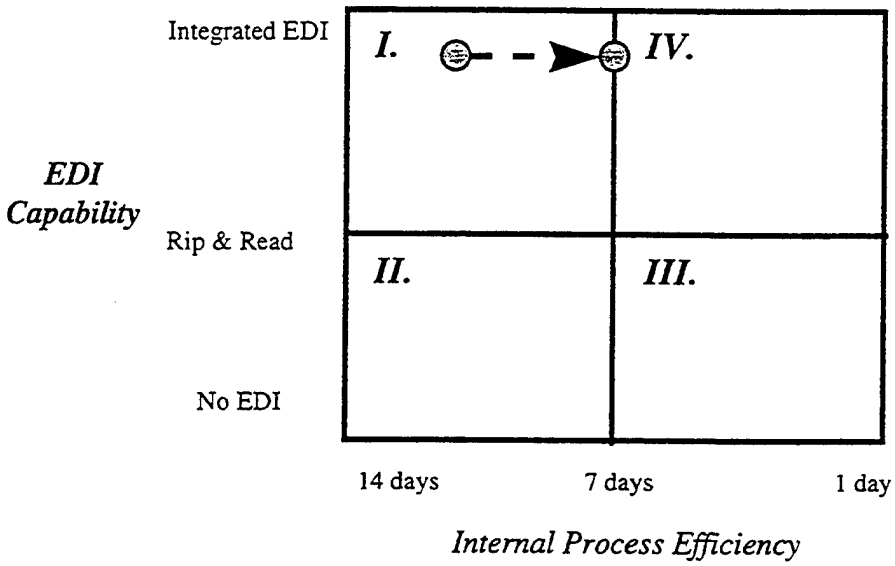

Figure 4-17. Atwood Automotive Improvement Matrix

Until December of 1995, Atwood offered only limited involvement in the MAP Project due to the lack of an internal champion and the belief that MAP-type improvements were of key importance to day to day operations. In December, the project team was able to obtain a larger commitment from Atwood, after gaining access to the VP of Manufacturing, who recognized the benefits of increasing participation in MAP. Several process analysis, improvement, and planning sessions were held during the spring of 1996 with personnel at the Atwood Stockton plant. The Stockton team created an aggressive plan for improvement, supported by quantitative metrics and goals.

The plan was never implemented for two reasons. First, Atwood personnel was consumed with fighting day-to-day fires. Although the improvement plan addressed the root causes of many of these problems, plant personnel was unable to organize a systematic effort to implement the plans. Second, Atwood Automotive was purchased shortly after the creation of the process improvement plan. The new owner put all on-going Atwood-originated improvement efforts on hold as it conducted an assessment of all Atwood plants and operations.

4.3.3 Specialty Screw

Tier: Three (Hardware)
MAP Product: Custom-engineered fasteners
Location: Rockford, IL

A representation of Specialty Screw's improvements in EDI Capability and Internal Process Efficiency is shown below:

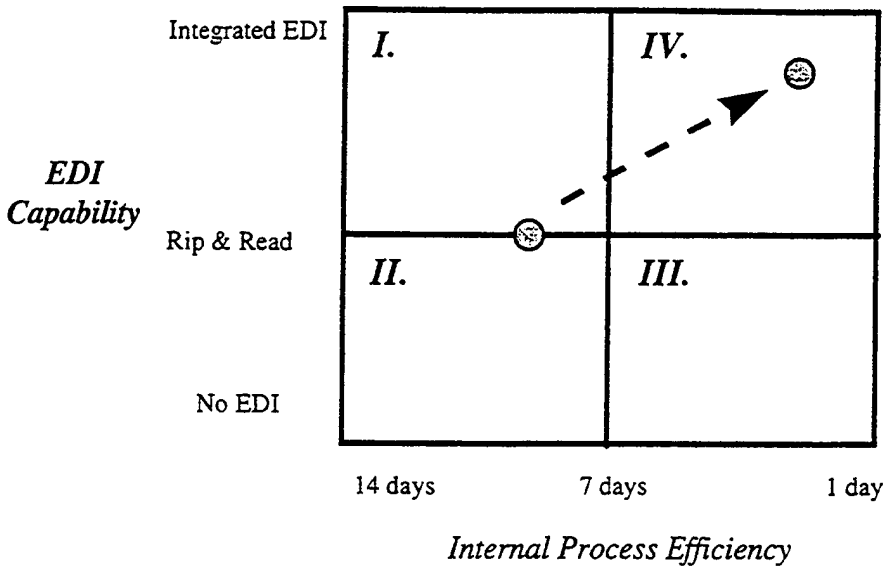

Figure 4-18. Specialty Screw Improvement Matrix

Specialty Screw conducted the following actions to update its EDI capability:

- Update EDI translation software to handle Atwood requirements
- Obtain Value Added Network services
- Expand business processes for electronic receipt and transmission of information
- Test and pilot EDI data exchange with Atwood
- Production EDI with Atwood

Specialty Screw possesses a talented internal MIS staff. Rather than employ outside service providers, the company chose to utilize its MIS staff to write the code to integrate EDI into its internal business systems. The following actions were completed by Specialty Screw personnel:

- Develop file translation software from EDI to business applications
- Develop interfaces between PC and UNIX systems to move data between EDI and business applications
- Test integrated systems
- Production use of integrated EDI and business applications

As expected, the first and most visible improvement experienced at Specialty Screw was a reduction in information flow lead time and error rates with a corresponding increase in productivity.

> "There are two ways by which I have seen improvement with EDI – the value of EDI has been seen in reducing the amount of time it takes to record customer releases. We have been able to reduce the time seventy five percent and we have been able to input the data accurately."
>
> - Russ Johansson, President, Specialty Screw
>
> "As a matter of fact we have gained the eight hours with just one customer. When you consider several of our other large customers, it is going to be an equal amount of savings,

times one, times two, times three, and will add up to a tremendous amount - and the payback will be very quick for any costs that you incurred."

- Bill Conkling, Controller, Specialty Screw

As Specialty Screw's controller explains, the company has seen an additional benefit from quicker information flows:

"There is a definite correlation between EDI and reduction in inventory. The more timely the information, the faster it comes to our company .... then we are better able to adjust the size of our lots, we can build smaller quantities and reduce our work in process inventory."

- Bill Conkling, Controller, Specialty Screw

In fact, Specialty Screw was able to reduce its work in process inventory by one-third by building eight weeks of forecast instead of twelve weeks. This process change translated to a savings of $500,000.

4.3.4 Rockford Spring

Tier: Three (Hardware)
MAP Product: Springs
Location: Rockford, IL

Rockford began the MAP project with no EDI capability and an internal information processing time of over one week. During the project, Rockford Spring implemented and integrated EDI and streamlined its business processes to achieve a one day lead time as depicted in Figure 4-19.

During phase I of the MAP project, the Rockford Spring project team constructed a set of IDEF (Integrated Definition Language) models of their order entry processes. It became apparent from the modeling sessions that the order entry process took over one week because order information passed through a series of hands, including those of the company owner, before finally being entered into the computer.

Each handoff necessitated at least one delay, and an authorization or manipulation of the data. The IDEF models and the modeling sessions themselves led Rockford staff to reengineer the order entry process, cutting information flow leadtime within the company by over one half.

After EDI was implemented, and subsequently integrated additional process improvements were executed that brought lead time down to within one day.

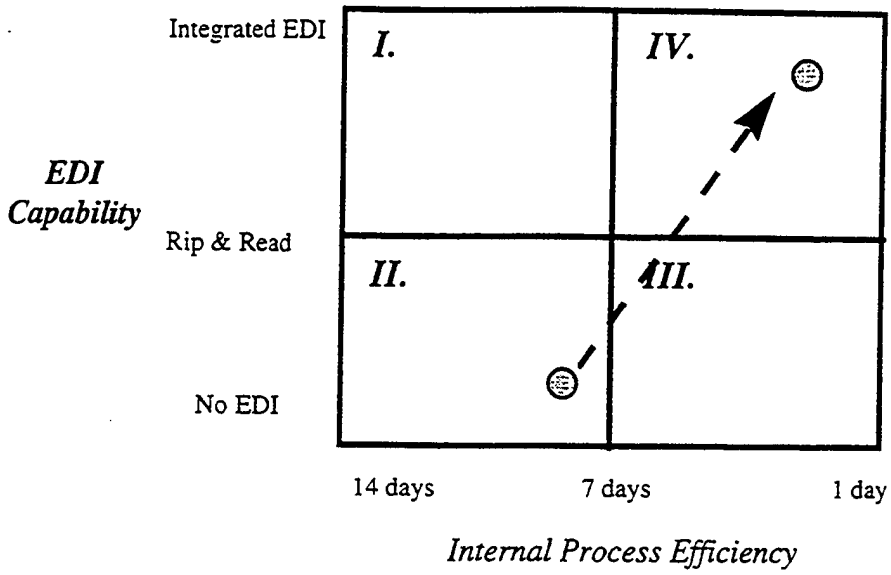

Figure 4-19. Rockford Spring Improvement Matrix

As explained below, the experience of Rockford Spring demonstrates that technology alone is not enough.

> "... EDI in itself is not a solution or an end. .... In order to accommodate EDI, and integrate it into your organization, you have to look at all your procedures, all your processes that relate to the EDI function, and in fact improve and streamline them. So, EDI in itself, brings you some capabilities you did not have, but it also forces you to improve your capabilities and your processes and procedures in other areas to insure it's just not another thing you have added, that is just transmitting information, or making things happen quicker – that should not have happened to begin with."
>
> - Bob Henneberry, Director of Sales, Rockford Spring

Rockford Spring has seen several benefits from implementing and integrating EDI. Not to be ignored is the impact that EDI capability has on a company's ability to attract new business:

> "... in our business the product is all the same... whether Rockford Spring makes it or whether spring company B makes it or whether spring company c—it is all the same product, no matter who makes it. .... So all we have to sell is service. And EDI is one of the things that we can use as a tool to sell to customers."
>
> - Bob Henneberry, Director of Sales, Rockford Spring

By combining EDI with process changes, Rockford Spring has been able to increase its competitive position and is able to better service customers.

> "In a short story, EDI reduces the total assets we have to have in place to support the customer, we can either increase our profitability and viability, and ability to stay in business, or we can invest that in newer technologies and reduce the price."
>
> - John Mink, Owner, Rockford Spring

4.3.5 EDI Case Study

It is often stated that small and medium size companies cannot benefit from the introduction of Electronic Data Interchange (EDI) into their business environment. This view of EDI in the small company needs to be revisited. Over the past three years, R-R Spring has gone from an environment where all business transactions were processed manually to the point where EDI is integrated into the order processing and

shop scheduling. Intermediate steps that lead to this accomplishment were the introduction of personal computers with manufacturing software and the implementation of 2-way EDI. All of this activity has resulted in a decrease in order processing time, shorter lead times for manufacturing, and a higher degree of customer satisfaction. This section details the R-R Spring benefits realized and describes their experiences in implementing EDI.

Company Background

R-R Spring Corporation is a small, privately held company located in Franklin Park, Illinois, a Chicago suburb next to O'Hare International Airport. The firm specializes in the manufacture of high quality springs for a variety of industries including marine engines, lock and door hardware manufacturers, and the auto industry. The company was founded in 1970. Initially the firm had 4 employees. It has now grown to 34 people with 1995 revenues in excess of $4,000,000. Growth over the last two years has averaged 20% per year.

Where R-R Started From:

In 1988, had a single personal computer, a 286 machine used for Statistical Process Control (SPC). This was their sole investment into computerization, aside from the CNC spring making machinery. In July of 1993, R-R purchased a 486 system and a modem to run an integrated manufacturing and accounting system. The software selected was Material Control System (MCS) from Zierdeen and Associates, a Chicago based vendor. Later that year, we added two smaller 486 configurations and connected these to the existing 486 personal computer using LANtastic. This established a simple local area network. The following year three additional 486 personal computers additional computers were added to the network. The table below indicates the cost of the initial computer environment at R-R Spring. This is the environment with which R-R entered 1994, the year they received their first inquiry as to what EDI capabilities they possessed. It was also the year they were asked if we would like to participate in the Automotive Industry Action Group's (AIAG) Manufacturing Assembly Pilot (MAP) project.

Initial Computer Environment Items	Cost
Six 486 Personal Computers	$11,100
MCS Software	$5,500
LANtastic Software	$1,100
Network Installation	$1,200

The EDI Inquiry Arrives

The EDI inquiry, from Mercury Marine, was actually a request to begin using EDI to receive release information via an ASC X12 830 transaction set. Since the inquiry from Mercury Marine was not a demand, R-R did not begin an immediate plan to implement EDI. The AIAG MAP project had as one of its main goals to improve the flow of information by the introduction of two-way EDI throughout a sixteen firm supply chain. This was to be followed by integration of EDI into the internal manufacturing systems in each firm. The first transaction set to be used by the MAP project was to be the 830 Release. This was very useful to R-R Spring since this was the same transaction set that Mercury Marine wished to exchange. By participating, R-R Spring hoped to achieve several business goals extremely important to their business operations.

Chief among these goals was the desire to implement EDI, not only with the MAP firms but, with all customers who were EDI capable, like Mercury Marine. Second, but of equal importance, was the integration of the EDI input into the MCS software. This would allow continuing the improvement in order processing and scheduling that had been realized by earlier efforts of automation.

At this point in time the accepted method of receiving releases and purchase orders was by fax and/or mail. The information was manually entered into the order processing system for inclusion into production scheduling and inventory systems. The plan at R-R Spring was to participate in the MAP project to develop a plan for 2-way EDI and the integration of EDI with existing systems. The planning activity would be quickly be followed by the implementation.

The Planning Process

Participation in the MAP project allowed R-R Spring to take advantage of a larger body of knowledge than might have been available under other circumstances. By coordinating the planning process with other members of the project team R-R was able to develop detailed plans for implementing EDI. The planning process not only involved technical details of the implementation but, equally as important, the planning for the business processes changes to support the proper use of the technology. Assistance with the technical aspects of the planning was provided by members of the technical staff of the Industrial Technology Institute (ITI). For business process planning, assistance came from Wizdom Systems. The planning and implementation was divided into two sets of activities. The first involved the activities required to establish two-way EDI with the existing trading partners. The second was the integration of EDI with existing internal systems. Formal written plans were developed for both of these activities. The plans included detailed tasks descriptions, rationale for the task, time schedules, and assignment of responsible individuals for execution of the tasks.

For two-way EDI the major components of the plan included:

- Obtaining and installing EDI translation software
- Obtaining Value Added Network services
- Establishing information mapping for the 830 transaction set
- Modifying business processes for electronic receipt and transmission of information
- Testing and piloting EDI data exchange
- Establishing production two-way EDI with customers

The main criteria in selecting an EDI translator package was the need to send and receive EDI transactions with multiple trading partners using differing implementation conventions. The package also needed to have file import and export capabilities to interface with the MCS software for future integration. The selected package handles all these requirements and operate in a personal computer environment.

VAN selection was performed as part of the planning activity. Mercury Marine and Atwood Automotive both used the same VAN. Cost comparisons showed this VAN to be competitive and the decision was made to use this service. The plan called for establishing EDI communications with Mercury Marine as a pilot for the MAP project. Then, when Atwood was ready to establish EDI communications with suppliers, the appropriate overlays for the EDI software would be added, trading partnerships set up, and Atwood EDI data tested.

The planning for the integration of EDI with the MCS software required coordination with Zierdeen and Associates. MCS did not have modules in place to handle the input of data directly from EDI transactions into the system. This capability had to be developed by the vendor.

The major components of the plan for integrating EDI included:

- Obtaining and installing EDI to business application interface software
- Modifying business processes for integrated EDI
- Testing integrated systems
- Production use of integrated EDI and business applications

Establishing file transfer and data exchange capabilities between the MCS system and the EDI translation package was the main piece of technical planning for this part of the project. Zierdeen was to provide a file conversion module to move data between MCS and EDI system. This would be accomplished by using the flat file export capability of the EDI software. The flat file created would be used as the input into MCS. Integration capability was to be based on the data analysis and comparison performed as part of the 2-way EDI implementation that would be completed prior to this activity. The most significant part of this plan revolved around the changes in business processes, as R-R moved from manual processing to integration of the EDI transactions into the MCS environment.

By July of 1995, R-R was ready to start the detailed technical implementation. Total cost for these activities was targeted at $6,760 for initial implementation with additional monthly VAN charges and annual maintenance fees. These costs are detailed in the charts below.

Initial EDI Implementation Items	Cost
EDI translation software	$2,400
Additional overlays	$600
MCS Integration Software Modules	$3,100
First year maintenance fee for EDI software	$660

On-going Items	Unit Cost/Basis
EDI software annual maintenance	$660/year
VAN mailbox maintenance fee	$53/month
VAN usage fees	est. $0.22/1000 characters

Implementation

The implementation of two-way EDI went very smoothly. Establishing communications over the VAN involved establishing the proper trading partner identifications and requirements. Since Atwood Automotive was not ready for testing, the effort started by setting up communications with Mercury Marine. This activity required some support from the VAN's technical support group but was completed within a day after starting the activity.

Installation of the EDI translation software took two to three hours. The vendor's technical support group assisted via the telephone but very little assistance was required. R-R was able to receive a Mercury marine transaction on the first attempt. The EDI software was very simple to use and connecting to the VAN was no problem. The release from Mercury contained real data and not just test items. R-R was able to use that release as input to the manual process of order input and scheduling. However, using the 830 formatted data was more difficult to use in a manual mode. The release received contained over 200 pages of information with each line item on a separate page. The pilot went so well with Mercury that the 830s being received from them were moved into production in September.

By November, Atwood Automotive was ready to begin testing their 830 release. Setting up the new trading partner information caused a few minor delays and R-R tried to jump ahead of the documentation. Another problem was that there were differences in how Mercury and Atwood set up their addressing using the DUNS number. This was not a significant problem and the first 830 were received from Atwood before Thanksgiving. Once again this was a real 830 and not just a test data set. Since R-R was already using the Mercury Marine release, they quickly moved the Atwood 830 into production with their manual systems.

During this EDI Integration phase of the implementation the first problem of serious consequences was encountered. Zierdeen and Associates had underestimated the amount of time required to develop the integration modules for the MCS software. This, coupled with some internal pressures generated by a new product for a customer, delayed the implementation of the integration. The integration software was delivered in February. R-R is now implementing new business processes to properly exploit the EDI integration.

Current EDI activity has expanded to three firms; Mercury Marine, Atwood Automotive and most recently Von Duprin. Mercury Marine ships a single 830 per month. Three 830 transactions are received per month from Atwood. Most recently R-R has started receiving 850 Purchase Orders from Von Duprin. Anticipated volume with Von Duprin is a maximum of two 850s per month. As a note, VAN costs for this level of activity have been averaging $65.00 per month. The activity with Von Duprin will expand to include two - three 860 Purchase Order Changes per week in the near future. Initial successes with two-way EDI are being repeated with the integration effort and hoped for benefits and savings are being realized.

Results

R-R Springs movement into computerized systems and Electronic Data Interchange has resulted in some very specific benefits. The immediate benefit has been the reduction in time lost in transit of business documents, both externally and internally. Having information available more quickly allows better production planning, scheduling, and material purchasing. This also contributes to shorter lead times, fewer expedited orders, faster response to customer requirement changes, and lower inventory levels.

Prior to the EDI effort R-R had reduced order processing time from two weeks down to two to three days. This resulted not only from the introduction of computers but also by leveraging the technology with improved processes and procedures. With the introduction of two-way EDI and EDI integration, further R-R has reduced order processing time down to 3 - 4 hours. This has allows generation of new production schedules more rapidly and more tightly scheduled production capacity. As a result, R-R has become more aggressive in developing new business with the confidence that they can quickly move this business into production and meet the customers delivery requirements.

As for cost improvements, this new capability is generating some $500 per week in cost savings over the old manual procedures. So, even though R-R entered the EDI activities with a strategic view of its importance, these activities have provided a real Return-On-Investment (ROI). The cost avoidance benefit received by not using manual system for the new business being generated is another plus. R-R Spring certainly feels that this experience has demonstrated the value of EDI for the typical small firm.

4.3.6 E-mail Case Study

Company Background

Specialty Screw was founded in 1953 in Rockford, IL. Specialty Screw manufactures a wide range of custom designed specialty fasteners and cold-formed metal components. These products are distributed primary to customers in the automotive, transportation equipment, lawn and garden, electrical, recreational and fabricated metal products industries. In 1979 the firm moved to its present facility in Rockford. The acquisition of the new facility and equipment in 1979, coupled with expansions in 1989 and 1994, enhanced the capabilities in the special fasteners market and allowed for diversification of the sales efforts. Currently the company has annual revenues approaching $15,000,000 and has approximately 500 customers with 65% of the business being with 1st or 2nd tier suppliers in the automotive sector.

E-mail Background

Specialty Screw Corporation has a UNIX based manufacturing information system. The company started using the UNIX *mail* command as its internal e-mail solution in 1989. The *mail* command was used in conjunction with script files to send very simple messages between users. The major problem with this implementation was that the system was not user friendly. Users found this system complex in comparison to the personal computer word processor being introduced into the computing environment within the

company at that time. The growing use of spreadsheets often lead to users asking for ways of sending this form of information to other company employees. This request was for both internal and external transmission. The Specialty Screw e-mail system at that time did not have external capability. In fact, to meet some early requests for external communication, a single account on one of the national on-line services was installed. This was the state of the Specialty Screw e-mail environment in 1994.

AIAG MAP Project Spurs E-mail Evolution

In 1994, Specialty Screw was asked if it would like to participate in the MAP project. This project has as its main goal the use of Electronic Commerce (EC) technologies to improve communications throughout a multi-level supply chain.

The MAP project called for the use of e-mail for non-EDI communications with trading partners, i.e., for exception and supplemental communication so long as its use will meet the immediate needs of the situation. This project recommendation prompted Specialty Screw Corporation to expand its e-mail capability.

Planning

Specialty Screw decided to look for an e-mail system that would meet their users requests for an enhanced system that would provide spell checking, address book capability, integration with word processing, spreadsheets, and be more user friendly than the existing UNIX *mail* command.

The initial planning process was to leverage Specialty Screw's existing Novell Network software by introducing Novell's GroupWise as an integrated desktop solution for e-mail. This would be connected to the Internet via an Internet Service Provider (ISP) thereby providing a common interface for the users both for internal and external e-mail. This system would meet all of the user requirements stated above and then some.

The only problem with this system was the cost. Initial cost would be in excess of $14,000 and this was more than management was willing to commit to the project at this time.

Since Specialty Screw had a UNIX server and was currently using e-mail internally, it was recommended that existing environment be leveraged by improving the user's e-mail interface and by establishing a more robust and direct external e-mail connection to the Internet.

The MAP Technical Team recommended using the PINE e-mail software and its associated PICO document editor software. This software was installed on the UNIX server and made it available internally. It was run in conjunction with the existing e-mail software until training of all users on the new software was completed.

The new software enhanced the e-mail environment by adding spell checking, message filing and address book features. In addition, this e-mail system supports the Multipurpose Internet Mail Extensions (MIME) capability. This capability allows the attachment of files generated by other applications such as word processors or spreadsheets to an e-mail message. This capability lessened the dependency of the end-users on the UNIX environment by permitting them to use their personal computer-based applications to generate the major part of the messages.

It was decided to provide the external e-mail connection using a commercial Internet Service Provider (ISP). The Internet was selected because it was the most cost-effective means of providing external e-mail connectivity. Cost varied, dependent upon the level of services desired, from a flat fee of $19.95 per month to an amount in excess of $700 per month.

The actual cost as implemented is given in the table below. Included in the table is the amount of time spent by the Specialty Screw internal staff planning and executing the e-mail implementation plus the time spent training the users.

Specialty Screw elected to register for the Domain Name on the Internet. A firm does not have to register itself on the Internet. However, a Domain Name provides a unique identification for a company on the Internet. E-mail can be received using the ISP as an 'In-Care-Off' type address.

E-mail Implementation Costs	Initial Setup	On-going
Internet Connection Services	$ 50.00	$50.00 per month
Domain Name Registration	$100.00	$75.00 per year
Specialty Screw Staff Time	1.5 staff months	1 day per month

Implementation

The implementation of the PINE e-mail system went very smoothly. The software was downloaded from the University of Washington and recompiled for the Specialty environment. This activity was accomplished in less than one week by the internal Specialty MIS group while maintaining all of their normal support duties.

The external connectivity was established using a dial-up link between Specialty Screw and the ISP gateway system. An internal server polls the ISP five times during the day to both transmit out-bound e-mail and receive incoming e-mail.

The users were then trained in a series of two hour training sessions. It should be noted that many users required no training since the PINE/PICO environment provides on-line help and uses a straight forward menu system to assist new users.

Business Use of E-mail

As a result of this implementation, direct customer communication via e-mail is starting to find its way into the main stream at Specialty Screw Corporation. Specialty Screw has tested e-mail with several customers and sales representatives. When a test is successful, the address is added to the global address book. This allows anyone on the system to send an external message. In the past messages could only be sent internally. To send the same message to a customer or sales representative externally, the message would get printed and faxed or an additional phone call would be made. Now it can be done in a single step from the desktop.

Another feature of the e-mail software is the ability to create a mail list. When a weekly or monthly meeting is established the chairperson creates a list of the meeting participants. By selecting the list all meeting members can then be contacted at once. This eases the distribution of meeting minutes and agendas for upcoming meetings.

The file attachment capability of the Specialty Screw e-mail system has also proven to be very valuable for business use. For example, the Human Resources department received a revised "Application for Employment" form from the corporate attorneys office located out of state. The form was a Word Perfect 6.0 document attached to a message. The use of e-mail to receive the document greatly streamlined the update procedure and minimized the chance for errors on the form due to retyping.

The e-mail system has also proven useful for company supported community activities. E-mail is used to transmit monthly messages to the Publications Chairperson of the Rockford chapter of the Data Processing Management Association. These are then transferred into the newsletter without retyping thereby saving time and reducing errors.

As new business uses for e-mail are being implemented, it has become apparent that Specialty Screw has an e-mail environment that is superior to a vast majority of its customers and suppliers. This is viewed as a positive position by the management of the company. This position further enhances the view that Specialty Screw is a forward thinking firm that is not only striving to provide superior products but also superior customer service.

Summary

E-mail has enhanced the daily business activities at Specialty Screw Corporation. Formal practices as well as ad hoc uses are growing. Future uses being discussed include sending CAD drawing files to customers

and suppliers as attachments. This will impact the "Request for Quotation" and "Customer Print Revision" processes. Specialty Screw's expanded use of e-mail has been very successful and strongly feel that they have improved internal and external communication through the use of e-mail.

4.4 Impact on Federal Procurement Practices

This section looks at the interaction of the Federal Acquisition Regulations (FAR) and Electronic Commerce (EC) technologies. In particular, we examine the impact of the Federal Acquisition Regulations (FAR) on the various recommendations proposed in the Automotive Industry Action Group's (AIAG) Manufacturing Assembly Pilot (MAP). While the MAP project dealt with commercial products and supply chains, many of the participating firms also do business with various Department of Defense (DoD) organizations. During the MAP project members of the technical staff of the Industrial Technology Institute (ITI) discussed the issues concerning the FAR and EC with various participants and government organizations. In addition, experiences and data gathered on previous DoD EC based projects was considered for this report. It should be noted that, when this project was proposed in 1993, the perceived, and to a large degree, the real view saw a conflict between the FAR and EC that was much greater than it is today. This rationalization process of the FAR and EC, in particular EDI, is a tribute to the various Federal organizations who have aggressively acted to move the Federal procurement practices in the electronic era.

The MAP project was established to pilot the streamlining of information flow through a multi-level supply chain. The Phase One report of the project, completed in December of 1994, made nine specific recommendations for technologies and processes to be implemented to accomplish information flow improvement[4]. These were:

1. Two-way EDI throughout supply chain
2. E-mail for ancillary communications
3. Supplemental communication to lower tiers when unusually large scale changes occurs
4. Communicate the full OEM planning horizon
5. Communicate the weekly OEM material release directly to lower tier suppliers
6. Communicate the OEM operating plan
7. Two-way Customer/Supplier Operations Education and Training
8. Integration of EDI into internal business systems
9. Coordinate releasing down the chain

One of the Advanced Research Projects Agency's (ARPA) goals for this pilot was to establish a business case for applying the knowledge gained from this project to DoD procurement activities. As a result, one of the concerns that arose in examining the applicability of the lessons learned into the DoD environment was what impact the Federal Acquisition Regulations would have on the transfer. That concern is addressed by examining the impact on the nine recommendations. In particular, it will look at public policy as it is applied to the emerging field of Electronic Commerce (EC).

The introduction of EC technologies into the Federal government procurement arena has received much publicity in the last three years. When President Clinton issued his Executive memorandum to streamline and simplify the acquisition process in October of 1993, there was much skepticism as to how quickly the government could really make doing business in the public sector easier. One of the major reasons for this skepticism was the existing Federal Acquisition Regulations (FAR). It was long felt that the FAR was one of the main roadblocks to reduce the perceived excess paperwork involved in dealing with the Federal government. Subsequent activities have shown the FAR is not the barrier it was once thought.

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[4] Manufacturing Assembly Pilot Project Phase One Report, Automotive Industry Action Group, December 13, 1994, page 12-34

One of the major forces in demonstrating that the FAR was not an impediment to EC was the work performed by the Federal Electronic Commerce Acquisition Team and the subsequent systems put in place by Federal organizations, such as the Defense Logistics Agency (DLA). In 1994 this group issued their report entitled; Streamlining Procurement Through Electronic Commerce. This report, over 350 pages in length, provides great detail on how to introduce EC in the procurement activity. However, this report does not call for the elimination of the FAR. It cites the fact that the FAR is matter of public policy meant to protect the American business community as well as insure that the public funds are controlled in a judicious manner. The report does call for streamlining the FAR to permit such EC activities as Electronic Data Interchange and Electronic Funds Transfer while still maintaining reasonable levels of control over the huge expenditures of public funds. It calls for a common interface to all Federal government activities through a virtual network called FTS2000. This network would act as a gateway between certified commercial Value-Added Networks (VAN), the Public Internet and the various governmental networks involved with procurement. These findings generated an intense effort within the various Federal government agencies to comply with the drive for streamlining procurement via EC.

At this same time, the 103rd Congress passed Senate Bill 1587, the Federal Acquisition Streamlining Act (FASA) of 1994. President Clinton, who had supported this measure, signed the bill into law shortly after its passage. This bill instructed the various Federal agencies involved in procurement to actively pursue EC strategies for these activities. It also called for the establishment of an electronic network to support these EC endeavors.

One of the most aggressive agencies in this endeavor is the Defense Logistics Agency (DLA). This agency has introduced several programs to utilize EC, especially in the areas of spare and replacement parts. Among these are the updated Paperless Order Placement System (POPS), for issuing purchase orders against long term contracts; the Electronic Procurement Program Interface (EPPI), using an expert system of business rules to interpret different procurement environments and generate the appropriate electronic transactions; and the Defense Procurement Award Contract System - Electronic Commerce (DPACS-EC), which is perhaps the most ambitious EDI-based program. The DPACS-EC program will encompass some 11 ASC X.12 transactions sets covering the full range of procurement activities from Requests For Quotes (RFQ) through Purchase Orders to final Invoicing and payment. All of these programs make exceptional use of EC while still maintaining strict adherence to the FAR.

This deployment of EC, especially EDI, in a FAR compliant environment demonstrates that the MAP recommendations involving EDI can be implemented with minimal impact by the FAR. Specifically, Recommendation # 1 for two-way EDI and # 8 for Integration of EDI into internal business systems. The FAR has allowed computer based data since the 1980's. EDI is now viewed as just another form of such data. FAR 4.703 (d) states: "Contractors may retain records in any medium (paper, electronic, microfilm, etc.) or any combination of media, as long as the requirements of this subpart are satisfied.[5] Even more specifically is FAR 4.5, Electronic Commerce In Contracting.

FAR 4.5 calls for the use of EC for solicitations, receiving responses to solicitations, issuing contracts and orders, receiving payment requests and even authorizes the use of electronic finds transfer (EFT) as a form of payment. It also calls out the use of EC to receive questions regarding solicitations. This last FAR 4.5 specified use of EC, supports MAP Recommendation # 2, E-mail for ancillary communications.

It is clear that the changes and additions to the FAR support MAP Recommendations # 1, # 2, and #8. But what of the other six recommendations.

MAP Recommendation # 7, Two-way Customer/Supplier Operations Education and Training, is another supported activity. The DLA and other Federal organizations, such as the Electronic Commerce Resource Centers (ECRC), are providing such education and training at various locations throughout the country. In addition, many private firms and consultants are jumping on the proverbial bandwagon and offering this training. This commercial offering of training is another indication of the widespread acceptance of EC within Federal procurement practices.

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[5] Federal Acquisition Regulation, CCH Incorporated, Chicago, Illinois, January 1, 1995

The connection between the other five recommendations and the FAR is not as clear. These recommendations had more to do with passing additional information down the supply chain to provide suppliers a better picture of what might be changing in the weeks and months ahead. This report did not find any evidence in the FAR or during discussions with the various agencies that directly conflicted with these recommendations. In fact, during peace-time, Federal procurement tends to operate on fixed numbers and schedules for large unit procurements such as vehicles, airplanes, etc. This is a major contrast to the Just-In-Time (JIT) environment of the commercial automotive industry that is driven by constantly changing sales figures and projections. A war-time environment might more closely resemble the commercial JIT climate but then an entirely different atmosphere would exist and the comparison would not be fair. In this latter environment, security and speed issues would be paramount and the FAR would be regularly waved to meet these conditions. Nothing was discovered strictly forbidding the other five recommendations and one can only conclude that they are outside the direct concern of the FAR.

This rapid growth of EC in areas which the FAR provides regulatory control raises an interesting point. This point is whether the FAR inhibits EC or if in fact EC makes adherence to the FAR easier. There can be little doubt that EC reduces paperwork and the associated human effort, but could it be possible that EC actually makes the FAR easier to live with in the area of procurement. This would indeed appear to be the case. EC, by allowing repositories of detailed FAR clauses that can be accessed only as needed, provide controlled EDI templates that insure the inclusion of FAR required information within the electronic format. This allows rapid access to procurement notices to insure that the business community can move into the 21st century exploiting rapidly expanding technologies in an environment that provides the oversight and control of the public funds through strict adherence to the FAR.

While the Manufacturing Assembly Pilot project dealt with commercial products and supply chains, many of the participating firms also do business with various DoD organizations. During the MAP project, members of the technical staff of the Industrial Technology Institute (ITI) discussed the issues concerning the FAR and EDI. In addition, past experience and data gathered on previous DoD EC based projects were incorporated to provide the materials presented in this paper.

One negative aspect of doing business with the government that is often cited is the difficulty of complying with the various parts of the FAR. The regulations were established to insure fair trade practices and to provide information that products meet manufacturing requirements with regard to materials content. Often the FAR is given as the major reason for the enormous amount of paper work required to do business with the government. In most cases the actual intend of the FAR is to protect American businesses and their workforce. The justification for the FAR is that since the American tax payers are providing the funds for governmental purchases, the revenues generated for businesses should go to domestic companies whenever possible. As a result many of the FAR clauses that generate the most complaints from the business community were actual put in place to protect the very organizations that most often complain.

It should be noted that in general, only those companies supplying directly to the government are impacted to any large degree by the FAR. This is because the FAR issues are processed by a particular firm in the chain that insures all FAR regulations are properly adhered to and monitored. The firm at the point were FAR compliance is controlled is called the Dual-Use Interface Point (DUIP). At this level and above in any given supply chain, all firms must process and comply with all FAR requirements. Below this point in most supply chains, FAR issues are not a concern. In addition, these DUIP and above firms must certify that all suppliers below the DUIP do meet any FAR requisites. This eliminates the burden of the FAR paperwork from the firms below the DUIP.

During the MAP project and previous work with the Tank Automotive Command (TACOM) a lot was heard about how 'bad' the FAR was while talking with vendors. However, during detail discussions, no vendor wanted to change any FAR except those dealing with price support procedures. As in the previous discussion, public policy requires many of the provisions in the FAR. A vendor's view of whether a FAR is good or bad depends on their current status within the procurement cycle. If a vendor is currently doing business with the government, and has learned how to work within the FAR arena, the FAR is viewed as a method that minimizes competition. If a company is not currently doing business with the government, the FAR is viewed with fear and often cited as a reason for not getting involved with government contracts. The sole exception to this is price support data. The price of items not commonly found in the commercial market, like titanium left-handed muffler bearings (an obviously fictitious example), must be supported by

paper documents, from TACOM all the way down the chain. The record-keeping burden for this FAR is apparently fairly heavy and, from interviews, it appears DoD auditors do not themselves understand the FAR. As a consequence, vendors above the DUIP keep lots of paper-based records and have instituted many accounting procedures to deal with the auditors. The requirement for paper apparently arises from the misinterpreted view of the auditors, which will be detailed later, that computer based records are changeable while paper is not. CD-ROM could serve as a substitute for paper, of course. As a note, the most frequent way of avoiding this requirement is to procure commercially available parts, for which price support records are not required.

The next section explores the relationship of the FAR and EC by first looking at initiatives within the Federal government to institute EC and seeing what these efforts state for requirements of FAR enforcement. This is followed by a description of several EC based programs within the Defense Logistics Agency. A brief discussion is then presented on the role of auditing and how it is impacted by EC and the FAR. An actual example of FAR follows and how EC, via EDI, can actually enhance an organization's efforts to comply with the regulation in an easier manner.

4.4.1 Government Initiatives for Electronic Commerce

The highest levels of the Federal government have been moving aggressively to provide a favorable climate for introducing electronic commerce into the various procurement activities throughout various agencies. One of the initial salvos of the current efforts was the issuance of the October 26, 1993 Executive memorandum issued by President Clinton. In this document the President set forth the following objectives for EC.

- Exchange acquisition information electronically between the private sector and the Federal government to the maximum extent possible.
- Provide businesses, including small, small-disadvantaged, and women-owned businesses, with greater access to Federal acquisition opportunities.
- Ensure that potential suppliers are provided simplified access to the Federal government's EC system.
- Employ nationally and internationally recognized data formats that serve to broaden and ease the interchange of data.
- Use agency and industry systems and networks to enable the government and potential suppliers to exchange information and have access to Federal acquisition data.

The memorandum continued by outlining four milestones:

- By March 1994, define the architecture for the government-wide EC acquisition system and identify executive departments or agencies responsible for developing, implementing, operating and maintaining the Federal electronic system.
- By September 1994, establish an initial EC capability to enable the Federal government and private suppliers to exchange standardized requests for quotations (RFQs), quotes, purchase orders and notice of awards.
- By July 1995, implement a full-scale Federal EC systems that expands initial capabilities to include electronic payments, document interchange, and supporting data bases.
- By January 1997, complete government-wide implementation of EC for appropriate Federal purchases, to maximum extent possible.

The memo was followed by the formation of the Electronic Commerce Acquisition Team which issued, what is now called the ECATS report, formally titled "Streamlining Procurement Through Electronic Commerce", on April 29, 1994. This report outlined how the Federal procurement process would be streamlined to improve procurement practices and how to insure that all firms, regardless of size, would be insured access to potential Federal procurements. The ECATS report emphasizes common procurement practices throughout the government with a single interface to a virtual network, called FTS2000, to potential suppliers. This virtual network would have a variety of certified Network Entry Points (NEP)

provided by current commercial Value Added Networks (VANs), the Public Internet and other networks. The FTS2000 would provide gateways to the various existing governmental networks and agency applications thereby eliminating special communications requirements to access the Federal government procurement opportunities. This report further stated that;

> A blizzard of paper barely describes the volume and variety of paper documents that are currently used to transact business between the government and its suppliers. The labor and time required to key and re-key information into computer systems and file and store all this paper is substantial. This largely human-processed information system is the single, largest source of excess time spent in the acquisition process. Implementing EC will encourage organizations to carefully examine their existing processes and to reengineer them to eliminate many unnecessary steps and to automate many of those that remain.[6]

With such strong statements and the widely held view that the FAR contribute to this "blizzard of paper", one would think that the ECATS report might advocate the elimination of such requirements. This is not the case at all. Let's examine several references to the FAR from the ECATS report.

When discussing RFQs and other solicitations, this reports reaffirms the necessity of certain FAR clauses. It states:

> "The Federal Acquisition Regulation (FAR) contains more than 500 provisions and clauses for various type of transactions. While some provisions are permissive, many are mandatory....(the report continues)
>
> The FAR provides uniform instructions for agencies on the placement of the provisions and clause in RFQs, solicitations and contracts. It spells out whether they must provide full text or referenced, and whether they are required, required-when-applicable, or optional. The FAR presents this information and identifies it in the form of 18 matrixes. Federal agencies generally use the same FAR provisions and clauses according to the various prescriptions for their use.
>
> The EC system should allow for the selection of provisions and clauses as well as easy access to the text of these various provisions and clauses."[7]

From this statement it can be seen that the Federal Electronic Commerce Acquisition Team took a very pragmatic view of the history of the FAR and did not attempt to become inbroiled in any actions to eliminate it as part of their requirement to streamline procurement. Such a position would have undoubtedly doomed their efforts from the very beginning or at the very least greatly extended the time it would have taken to implement EC within the Federal government. However, the team did recognize the need to modify the FAR in certain areas.

> "There are several minor changes that need to be made to the FAR to set electronic contracting methods on a par with paper methods.
>
> The Defense Acquisition Regulation (DAR) Council has undertaken the task of placing electronic methods on a par with paper methods within the FAR. It has generated the needed FAR changes and is starting the review process, but much work still needs to be done. .....(the report continues)
>
> For Example, an offeror should be able to provide discounts for prompt payments through EDI at the time the offeror registers to become a trading partner with the Federal government. This discount terms offered by this method would apply to all payments to the offeror and eliminate the need for the offeror to repetitively provide this data to the

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[6] Streamlining procurement Through Electronic Commerce; Federal Electronic Commerce Acquisition Team Report, 1994, page xiii

[7] Streamlining procurement Through Electronic Commerce; Federal Electronic Commerce Acquisition Team Report, 1994, page 2-22

government on contract and invoices. EC trading partners will be allowed to provide, at the time of registration, their payment discount terms (e.g., 2.10 net 30) to apply to payments made to them. The ***FAR may need to be changed*** to allow EDI notification of discounts for prompt payment at time of registration into EDI."[8]

In the above statement it is clear that the ECATS report did understand that some modification would be required to fully implement EC within the Federal procurement activity. One final example is given below to show that the Federal Electronic Commerce Acquisition Team was addressing real problems when discussing the size and complexity of the FAR.

> Rather than transmit full text clauses, representations, and certifications in EC transactions, standard integrated information accessible to all trading partners through a text file, should be established. This file would provide trading partners, upon request, with the full text of the clauses, representations and certifications, and TPA, including the following:
>
> - An integrated Federal EC master solicitation data base. This Federal EC master solicitation could be used to develop several tailored master solicitations that would provide the full text that reflects a broad category of acquisition (i.e., developed for a specific commodity.)
> - A complete electronic copy of the FAR and supplemental regulations, provisions, and clauses. This would allow for more accurate, timely, and cost-effective maintenance of these regulations.
>
> The GSA should be responsible for establishing a standard TPA and policy. Any trading partner would have access to the agreement since none of the information contained would be confidential. During registration, a trading partner would electronically acknowledge agreement to be bound by the TPA. Changes made by the government to the TPA would be electronically distributed to the VANs and the trading partner. All changes must be acknowledged by the trading partner.[9]

From this statement it can be seen that this report was addressing a very real concern around the use of the FAR for EC, that being the volume of data to transmit across VANs. By advocating standard trading partner agreements (TPA) and the on-line access to these and other parts of the FAR, only those parts of concern need be accessed. In addition, by allowing for the transmission of changes, large volumes of redundant data would not have to accompany the changed clauses. While this report described what was needed to be done to improve Federal procurement practices, a second important item was passed by Congress in 1994.

On January 25, 1994, the 103rd Congress passed Senate Bill 1587, the Federal Acquisition Streamlining Act (FASA) of 1994, which President Clinton signed into law.

This piece of legislation mandated that the Federal Government create a network for spreading electronic commerce throughout the Federal Government. It replaced the existing $25,000 "small purchase threshold" with a larger limit of $100,000 for "simplified acquisition threshold" for future streamlining activities. It should be noted that over 98% of individual purchase actions are for less than $25,000. This Act obviously opens the door for a huge amount of EC trading within the Federal procurement activity. This initiative spurred the introduction of the Federal Acquisition Computer Network (FACNET). FACNET today has many of the characteristics that had been called for in the definition of the FTS2000 network called for in the ECATS report.

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[8] Streamlining procurement Through Electronic Commerce; Federal Electronic Commerce Acquisition Team Report, 1994, page 3-20

[9] Streamlining procurement Through Electronic Commerce; Federal Electronic Commerce Acquisition Team Report, 1994, page 3-15

The establishment of FACNET had a significant impact on the FAR. In fact, an entire subpart, 4.5 Electronic Commerce In Contracting, was added to the FAR. As the scope states; "This subpart provides policy and procedures for the establishment and use of the Federal Acquisition Computer Network (FACNET) as required by section 30 of the Office of Federal Procurement Policy (OFPP) Act(41 U.S.C. 426). FAR 4.504, given below, states quite clearly that EC, in particular EDI, is to play a major role in Federal procurement.

4.504 FACNET functions.

(a) FACNET will permit agencies to do the following electronically--

(1) Provide widespread public notice of contracting opportunities, and issue solicitations;

(2) Receive responses to solicitations and associated requests for information;

(3) Provide widespread public notice of contract awards and issuance of orders (including price);

(4) Receive questions regarding solicitations, if practicable;

(5) Issue contracts and orders, if practicable;

(6) Initiate payments to contractors, if practicable; and

(7) Archive data relating to each procurement action.

(b) FACNET will permit the private sector to do the following electronically--

(1) Access notices of solicitations;

(2) Access and review solicitations;

(3) Respond to solicitations;

(4) Receive contracts and orders, if practicable;

(5) Access information on contract awards and issuance of orders; and

(6) Receive payment by purchase card, electronic funds transfer, or other automated means, if practicable.

As can be seen, FACNET's function description in the FAR 4.504 promotes EC very aggressively throughout the procurement process. Paragraph 4.504 (a) (4) encourages the use of electronic means for receiving and answering questions. This clause supports MAP Recommendation # 2, E-mail for ancillary communications.

In addition, this deployment of EC, in a FAR compliant environment, demonstrates that the MAP recommendations involving EDI can be implemented with minimal impact by the FAR. The MAP Recommendation # 1 for Two-way EDI is expressly supported by the FAR clause above. Recommendation # 8 for Integration of EDI into internal business systems, while not specifically cited can only be viewed as a necessary way for businesses to improve their internal processes to comply with the spirit of external streamlining. The FAR has allowed computer based data since the 1980's. EDI is now viewed as just another form of that data. FAR 4.703 (d) states: "Contractors may retain records in any medium (paper, electronic, microfilm, etc.) or any combination of media, as long as the requirements of this subpart are satisfied.

4.4.2 Defense Logistics Agency's EC Programs

When it comes to implementing EC, one of the most aggressive groups of government agencies are the organizations within the Defense Logistics Agency. These organizations have been moving towards electronic movement of procurement documents with heavy utilization of EDI in their business practices. Interviews with DLA personnel at the Defense Supply Center - Columbus (DSCC) left little doubt that their view was that the FAR does not impede the implementation of EC. This organization is implementing several EDI based systems to streamline their activities, particularly in the area of spares acquisition. These systems help them process anywhere from 4,000 to 5,000 orders per month. The dollar amount on these

streamlined EDI based systems is currently set by the Simplified Acquisition Threshold at $50,000 or less. When the DPACS-EC system described below is fully functional, this limit will be raised to $100,000 or less. Items above $100,000 will still go the Commerce Business Daily (CBD) for announcement of the RFQ per FAR requirements. However, discussions have begun on moving this data electronically to the CBD and the CBD is now available on-line. The DSCC also maintains an Electronic Bulletin Board with dial-in access for suppliers who wish to download RFQs. The FAR does require the DSCC to maintain a physical Bid Board. All announcements are posted on the board. This is a remnant of the old days when vendor sales representatives would call or visit the centers to see what new awards were being posted for bids. One DCCS employee has been considering the idea of replacing the Bid Board with an on-line terminal in the lobby. The FAR cited merely requires that a visitor be able to view all current announcements. The major systems currently being used or under development at the DSCC are listed below.

POPS - Paperless Order Placement System

This system is targeted at items that tend to be catalogue parts that have pricing agreed to prior to placing the order. They are based on long-term contracts that do not require RFQs. The items are acquired by issuing delivery orders. By not requiring RFQs for each order, transactions are minimized both for the DSCC and the suppliers. This approach follows the spirit of the ECATS report by not requiring extensive FARs transmission with each order. A new version of POPS has been tested and is moving into field test during the first quarter of 1996. Oshkosh Truck PDC will be participating in one of these tests. A very simple 850 Purchase Order template running with Supply Tech's STX EDI translation software for a personal computer is distributed to the suppliers. The template has basic header information and then line item information for the parts being ordered. No FAR information is transmitted as part of the 850 transaction set.

EPPI - Electronic Procurement Program Interface

This system is a replacement for POPS. It is a rules-based set of program modules that process different business rules when working with RFQs and Purchase Orders. The system will generate 850 transaction sets with minutes, or at the worst, hours of completion of the quote. It is the first attempt at applying rules-based expert systems in the Federal procurement activity.

Fast Pay

This system is a collection of qualified parts that are paid by Electronic Funds Transfer upon receipt and processing of the ASC X.12 810 Invoice from a supplier. These non-original parts or spares, are part of a well established contractual agreement between the supplier and the government. In this case, the FAR specifically cites an example of the streamlining EDI permit. FAR 13.303 states that if FACNET is used when placing an order, a paper form is not required. The text of this paragraph is given below.

> 13.303 Preparation and execution of orders.
>
> (a) Except when orders are placed via FACNET, orders incorporating the fast payment procedure should be issued on Optional Form 347, Order for Supplies
>
> or Services, or other agency authorized purchase order form (see 13.204(e) for purchases under BPAs). Orders may be either priced or unpriced.

DPACS-EC: Defense Procurement Award Contract System - Electronic Commerce

This is the most ambitious EDI-based system being developed for the DLA. Initial testing is completed using the ASC X.12 840 RFQ, 843 Response to RFQ and 850 Purchase Order transaction sets. The scope of transactions will be expanded to include the ASC X.12 824 Application Advice, 860 Purchase Order Change, 865 Purchase Order Change Acknowledgment/Request, 856 Advanced Shipping Notice and the 864 Text Message. This system will always use the 997 Functional Acknowledgment. This system is being developed for all DLA organizations and is considered to be fully FAR compliant.

Another system of interest being implemented by the government to speed non-procurement specific activities by EC is the Automated Bidset Interface (ABI) for obtaining Technical Data Packages (TDP).

This system was tested during the summer of 1995 and approved for use. A potential vendor uses an ASC X.12 841 Specifications/Technical Information transaction set to request a particular TDP. The appropriate TDP is then sent via a second 841 transaction. This system can also master CD-ROMs. The drawings are stored in a repository using the CALS JEDMICS format.

As can be seen by the extensive use of EDI within the DLA, Electronic Commerce and the FAR are not viewed as being at odds but can coexist in this area of Federal government procurement very easily. Let's now take a quick look at the other end of the procurement cycle, that of auditing.

EC And Auditing

Despite what many companies feel, Federal audit requirements do not limit the use of EC technologies, especially EDI. Organizations are required to store transaction electronically for the periods of times specified by the FAR. However, there is no specific requirement for paper copies. In fact, according the Defense Contract Audit Agency contacted during the research for this report, government audit offices are developing personal computer based tools using spreadsheets to assist them in downloading data directly from suppliers data bases to be processed upon return to the auditors office.

One item that does present a possible impediment of EDI is the oft cited requirement for documents with actual signatures. However, once again the FAR is specific about the need for signatures. In the case of FACNET based EDI purchase orders, FAR 13.506 states what is necessary for an unsigned electronic purchase order.

13.506 Unsigned electronic purchase orders.

(a) An unsigned electronic purchase order (EPO) may be issued when the following conditions are present

  (1) Its use is more advantageous to the Government than any other simplified acquisition method;

  (2) It is acceptable to the supplier;

  (3) It is approved by the contracting officer;

  (4) It does not require written acceptance by the supplier; and

  (5) The purchasing office retains all contract administration functions.

(b) When an unsigned EPO is used

  (1) Appropriate clauses shall be incorporated by reference;

  (2) Administrative information that is not needed by the supplier shall be placed only on copies intended for internal distribution;

  (3) The same distribution shall be made of the unsigned EPO as is made of signed purchase orders; and

  (4) No purchase order form is required.

(c) An unsigned EPO may be unpriced if it meets the conditions in 13.502.

If signatures are required, the FAR does allow for electronic facsimile for said signatures as long as the documents are reproducible. FAR clause 4.703 (c) (1) states:

> The contractor or subcontractor has established procedures to ensure that the imaging process preserves accurate images of the original records, including signatures and other written or graphic images, and that the imaging process is reliable and secure so as to maintain the integrity of the records....

FAR 4.703 has several other clauses that call out the need for retention periods of electronic data documents so as to satisfy audit requirements. All of these requirements state that computer data and records are satisfactory. Therefore, there is nothing in audit requirements that preclude the use of EC technologies in Federal procurement activities.

4.4.3 Using EDI to Enhance FAR Compliance

Accepting the fact that FARs exist and are not going away in the near future let's explore an example of the premises that EDI may actually enable, or at a minimum enhance, a firms ability to comply with specific FARs. As a note, this example was taken from the Oshkosh Truck Corporation's Supplier Standards Guide. This manual is provided to all trading partners to insure compliance with all federal regulations, Oshkosh quality standards and other Oshkosh specific business requirements such as shipping labels, etc. The first example is from a DFARS resulting from a legislative act, the Buy American Act - - Trade Agreement -- Balance of Payments Program Certificate (JAN 1994) DFARS 252.225-7006.

DFARS 252.225-7006 requires a statement of domestic end product either as part of a Purchase Order or as part of a solicitation (RFQ). Oshkosh states they will keep this information on file as needed. As stated in the Oshkosh Supplier Standards Guide:

A. "I hereby certify that each end product, except the end products listed below, is a 'domestic end product' (as defined in FAR 52.225.9 "But American Act - Trade Agreements - Balance of Payment Program (JAN 1994)" and components of unknown origin are considered to have been mined, produced, or manufactured outside the United States or a qualifying country. I certify that the following supplies qualify as 'U.S. made end products but do meet the definition of 'domestic end product':

LINE ITEM NO.	COUNTRY OF ORIGIN
_____	_____
_____	_____
_____	_____

B. (1) I certify that the following supplies are qualifying country end products.

_____

(insert line item number)

(2) I certify that the following supplies qualify as designated country end products.

_____

(insert line item number)

(This section continues with paragraphs like (1) and (2) for certifying Caribbean Basin Country, NAFTA and nondesignated country end products line item numbers.)

To comply with this DFARS, the supplier on a paper Response to a RFQ or Purchase Order would have to either attach an addendum or generate a special manual document counting this information. Either case introduces the possibility of information being left out because the generation of the RFQ response or PO is special and the person generating may forget to include the required data. Another possibility for failure to include the data would be the case when the regular work staff might be on vacation or out for a sick day. In either case, if EDI could help minimize the potential for exclusion or other errors. First let's look at the case for an RFQ.

If EDI was in place in the quote cycle, the RFQ would be received by the potential supplier via an ANS X.12 840 transaction set. Since the supplier would be familiar with Oshkosh's Supplier Standards Guide, an ANS X.12 843 Reply to an RFQ template could be generated to include notes fields for the above information. The template might include the information for the line item loop within an MSG (Message Text) segment of the 840 or as an overall note field for the entire quote. The safest way would be to include the appropriate statement as a note within each quoted item. Once this information is provided with the Quote there would be no further need to supply it with additional transaction actions. If there was a change in the required information, this data could be provided once again as a MSG segment in the line item loop

of an ANS X.12 865 Purchase Order Change. Such conventions would have to be established as part of the trading partner agreement.

This example illustrates a very simplistic, but complete method of meeting the FAR requirement by using EDI transaction definitions. By making the MSG segments mandatory with a well documented format, the chance of non-compliance to the FAR would be greatly reduced. Thus this is an example of an EC technology actually enhancing the compliance to Federal Acquisition Regulations.

A second approach to using EC to insure FAR compliance and at the same time permit smaller firms to fully participate in the Federal procurement activity is to utilize one of the commercial services offering an interface into the Federal procurement arena. These systems, such as Advanced Communications Systems, offer a large variety of capabilities. They will monitor solicitations looking for ones that are requesting products or services that match a firms capabilities. This includes sending the firm the RFQ and generating the quote to reply to the solicitation. If an award is given, these service bureaus will forward the purchase order. They will even provide the service of registering a firm with the Federal Vendors Registration Database. All of these services can be provided economically to a firm because they are a standard, well-defined procedures and processes established within the Federal Government procurement activity.

4.4.4 Summary

This section has provided insight into the relationship between the Federal Acquisition Regulations and Electronic Commerce. While there was and continues to be a need for an evolution of the FAR, there is no intrinsic impediment to electronic commerce contained within this set of controls. In fact, there is a clear case for the position that EC actually enables the business community to better comply with the letter of the FAR without allowing such compliance to be a barrier to doing business with the Federal government. By allowing electronic access to a common interface to the Federal procurement network, EC technologies are insuring that all elements, regardless of size, of the American business community can compete equally for government procurement awards in the most efficient manner.

When considering the nine MAP recommendations as part of EC implementation, the following summarizes the impact of the FAR on each.

MAP Recommendations # 1, Two-way EDI and # 2, E-mail for ancillary communication are directly supported by various sections of the FAR, in particular Part 4.5. MAP Recommendation #8, EDI integration is clearly supported by the spirit of Federal streamlining effort. Improving internal business practices, the main goal of this recommendation is a natural consequence of the drive to improve external processes. MAP Recommendation # 7, Two-way Customer/Supplier Operations Education and Training, is another supported activity. The DLA and other Federal organizations, such as the Electronic Commerce Resource Centers (ECRC), are providing such education and training at various locations throughout the country. In addition, many private firms and consultants are also offering this training. This commercial offering of training is another indication of the widespread acceptance of EC within Federal procurement.

The connection between the other five recommendations and the FAR is not as clear. These recommendations were designed to pass additional information down the supply chain to provide suppliers a better picture for mid-range planning. This report did not find any evidence in the FAR, or during discussions with the various agencies, that directly conflicted with these recommendations. Normal Federal procurement tends to operate on fixed numbers and schedules for large unit procurements such as vehicles, airplanes, etc. This is a major contrast to the Just-In-Time (JIT) environment of the commercial automotive industry that is driven by 10 day sales figures and projections. An emergency environment, such as a major conflict, might more closely resemble the commercial JIT climate. But then, an entirely different atmosphere would exist and the comparison would not be fair. In this latter environment, security and speed issues would be paramount, and the FAR would be regularly waved to meet these conditions. Thus, this report discovered nothing forbidding the other five recommendations and can only conclude that they are outside the direct concern of the FAR.

5. Program Benefits

The following two sections detail the benefits gained within the MAP supply chain and offer a detailed explanation of the rationale for implementing MAP-type recommendations a) within supply chains, and b) within individual companies. Both components of the argument are extremely important.

Upper tier suppliers stand to reap significant savings by taking waste out of their supply base. Half the cost of a product comes from its supply base. Thus, a typical company can only impact 50% of its costs by focusing on increasing efficiencies within its own walls. Costs incurred in a supply chain are passed up through its tiers and ultimately paid by the consumer. Inefficiencies at any level or in the system itself add cost and threaten chain competitiveness.

Thus, upper tier suppliers have an inherent interest in managing their supply base and are likely to respond to a business case made at the level of the supply chain. This business case is presented in section 5.3.1.

To reengineer a supply chain, all companies must buy into and implement the recommended practices. Lower tier suppliers, particularly small, bottom-tier suppliers, are in a different position. Company owners are not likely to be swayed by global, supply chain arguments.

In order for change to occur at the lower tiers, the decision makers must believe that such changes are indeed in the best interests of the company and will generate a positive return on investment. For this reason it is crucial to construct a business case for individual, particularly small, companies. This business case is contained in section 5.3.2.

5.1 Business Case for Whole Supply Chain

This section presents the business case for broad adoption of technologies and practices that improve the flow of material requirements within supply chains. The business case is based upon extrapolated savings in the following four metrics:

- Inventory Reductions
- Premium Freight Reductions
- Unplanned Changeovers
- Processing Costs

In reality, there are likely to be additional savings gained. For the sake of remaining conservative we limit our extrapolation to these four factors. We offer a low, expected, and best case of the anticipated savings along each of these dimensions.

The impact of project recommendations on the MAP supply chain is undeniable. The most visible improvement is that of lead time reduction. After implementing and integrating EDI and streamlining business practices, the hardware chain made a 58% reduction in lead time, from twenty-six days to eleven days.

The hardware chain displayed significant improvement at each tier within the chain. Of the overall improvement of 15 days, two days were eliminated at both the first and second tiers and eleven from the third tier. The improvements at the top two tiers were predominately produced by improved business processes while that at the third tier was from a combination of the initial implementation of EDI as well as improved business practices.

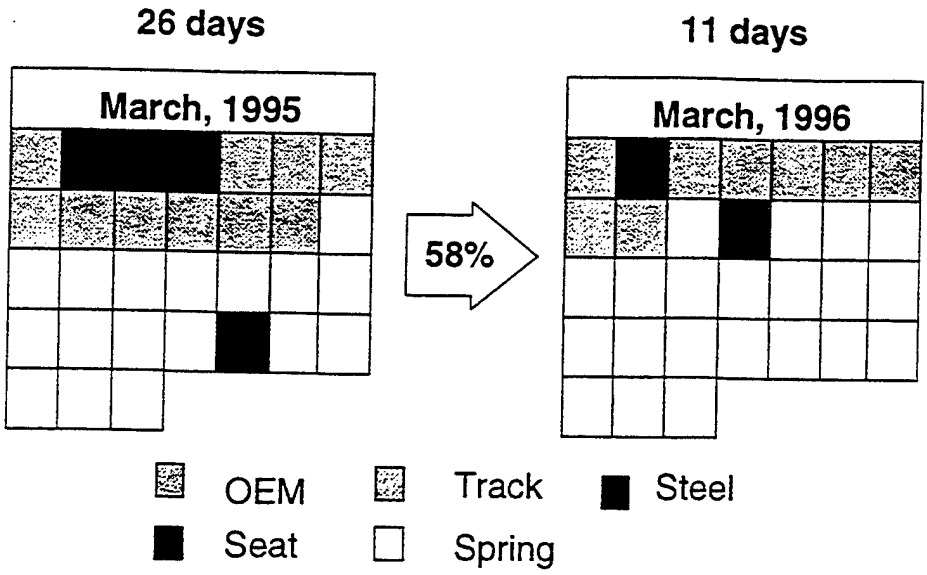

Figure 5-1. Information Flow Lead Time: Hardware Chain

The trim chain reduced lead time by thirty-two percent, from nineteen to thirteen days. Improvement for the supply chain was six days.

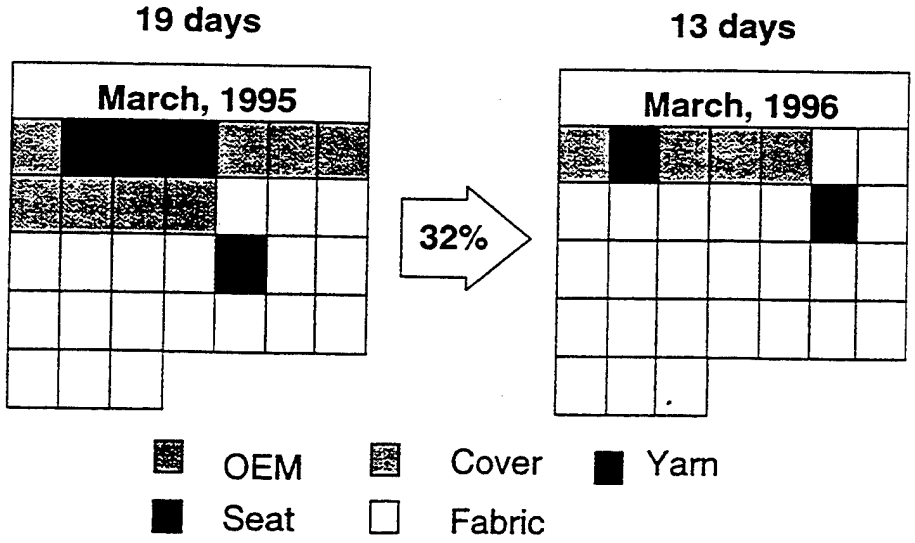

Figure 5-2. Information Flow Lead Time: Trim Chain

Only a handful of MAP companies are currently requiring more than one day to receive, process, and send out material releases. In each of these cases, plans are currently in place to bring lead time down to the goal of one day per tier. The MAP project has shown that one day per tier is achievable and has significant impact on the supply chain. For additional information on the causes of lead time reductions see the **Final Evaluation Report**. These reductions in lead time drove the following additional savings in the MAP chain.

Inventory Reductions

Inventory reductions make a strong case for the implementation of MAP project recommended practices. Improved information facilitates the management of inventory and reduces the need for "just-in-case" inventories. Therefore, the expectation of the MAP project was that reduced inventory levels would be seen following the implementation of EDI throughout the supply chain. Within both the hardware and the trim supply chains, the MAP project unveiled significant improvement in inventory turns.

Expected size of inventory reductions: Low, Expected, and Best Cases

The metric findings, which amounted to 17% in the hardware chain and 24% in the trim chain respectively, include improvements from non-MAP factors at participating companies. Company personnel often had a difficult time distinguishing between the impact of MAP type recommendations and other improvement efforts. On average, there was agreement that the implementation of MAP type recommendations allows a decrease in inventory levels. Conservative expectations of the potential for reductions in inventory levels are believed to be 10%, +/- 5% for low and best case analysis, for all tiers below the first. Tier one inventory reductions are set somewhat lower, 5% +/- 5%, due the fact that tier 1 suppliers already do EDI with the OEMs, and a greater percentage of the tier 1s possess integrated EDI than do lower tier suppliers. Even so, the benefits of implementing EDI with more and more of their supply base and streamlining business processes can be reasonably expected to allow a reduction in inventory levels.

Expected Value of Inventory Reductions

There are two savings associated with a reduction in inventory.

1) Improved cash flow: the money tied up in inventory becomes freed up to be invested where it can generate the highest return.

2) Reduced carrying cost of inventory

Our analysis focuses on the reduction of carrying costs, which incorporates the cost of capital locked up in inventory. Carrying costs of inventory tend to average 25% of total inventory levels. These costs represent all costs associated with decreasing inventory and includes all associated costs relating to holding inventory; costs of capital, carrying and moving costs, and obsolescence. Carrying costs tend to increase or decrease proportionally with inventory levels. Thus, a decrease of $ 100 in average inventory levels tends to lead to an annual savings of $25 in carrying costs.

The following reductions in inventory, and associated annual savings through reductions in carrying cost can be expected to be achieved from industry-wide adoption of MAP recommended practices.

	Inventory Reduction			Anticipated Annual Savings		
Tier	Low	Expected	Best	Low	Expected	Best
Tier 1	None	$ 0.78 B	$ 1.56 B	None	$ 195 M	$ 390 M
Lower Tiers	$ 0.78	$ 1.56 B	$ 2.34 B	$ 195 M	$ 390 M	$ 585 M
Total Industry	**$ 0.78 B**	**$ 2.34 B**	**$ 3.90 B**	**$ 195 M**	**$585 M**	**$975 M**

Figure 5-3. Inventory Reductions and Anticipated Annual Savings

As Figure 5-3 details, savings from reduced inventories resulting from MAP project-type improvements can be expected to amount to $585M. These savings assume total inventory levels of $31.25B for both tier one and for all lower tiers, which represents an average inventory turn level of 8.0 throughout the automotive industry.

Premium Freight

There is little question that by improving the quality of and the speed which information flows through a supply chain, spending on premium freight can be reduced. Due to idiosyncrasies of the MAP supply chain, discussed above, the premium freight metric did not generate significant results. This should not be interpreted that there are no such savings to be made.

Sufficient anecdotal evidence, combined with common reasoning, exists to build a sound causal relationship between the industry-wide implementation of MAP recommended practices and a reduction in systemic spending on premium freight. Shorter supply chain lead times result in better and quicker information which gives suppliers more advance notice and allows for better scheduling of productive capacity. With fewer last minute surprises, suppliers do not need to ship materials to their customers at a premium as often. This leads to a decrease in the total amount spent on premium freight in the supply chain. The potential for savings can be substantial. Milliken reported significant reductions in spending on premium freight as a result of EDI and changing business processes. According to Russ Johansson, President of Specialty Screw improved information flows from customers, achievable through the wide spread adoption of EDI technology, could result in a 90% reduction in premium freight for his company.

It is reasonable and conservative to expect savings. Total automotive industry spending on premium freight is currently estimated to be approximately $825 million. We have estimated savings at the rate of 5%, 10%, and 15% in the low, expected, and best cases.

	Low	Expected	Best
Total Anticipated Savings	**$41.25 M**	**$82.5 M**	**$123.75 M**

Figure 5-4. Savings Resulting from Decreased Spending on Premium Freight

Based upon the total premium freight expense within the automotive industry to be $825M, total savings of $82.5M can be expected for the entire supply chain.

Unplanned Changeovers

Suppliers who possess flexible, Just-In-Time manufacturing systems are able to respond to short-notice changes in demand without incurring the cost of changeovers. These suppliers tend to be, although are not limited to, upper tier. Below the first tier, more and more suppliers are manufacturing in batch processes with long production runs. Breaking these runs is expensive. A changeover can take, on average, eight hours to complete. There is the cost of labor, lost production time, and of quality before the process is brought into control. Although few MAP project participants reported a significant number of unplanned changeovers for reasons listed above

Unplanned changeovers can be expected to decrease with the implementation of EDI throughout the supply chain. Quicker and more accurate information decease the need for "rush-jobs" that often results in an unplanned changeover.

Expected size of reduction in unplanned changeovers: Low, Expected, and Best Cases

For the sake of conservatism, we have assumed an estimated reduction of zero, two, and four unplanned changeovers annually as a result of receiving more reliable information sooner from customers. We have assumed that 20,000 suppliers, a subset of the entire automotive industry, will reap these benefits.

Expected value of reduction in unplanned changeovers

The cost of each changeover is valued at $2,000. This is based upon an estimate of labor cost and cost of quality drawn from the MAP project experience.

	Low	Expected	Best
Total Anticipated Savings	**$ 0 M**	**$ 80 M**	**$ 160 M**

Figure 5-5. Extrapolated Savings in Unplanned Changeovers

Processing Costs

> "We have experienced at least a sixty seven percent productivity gain in that one area (material planning and logistics) as a result of this. To me any supplier has the same opportunity if they are willing to go out and grab this tool, use it and ask their suppliers to do the same thing–go all the way down, first tier, second tier, third tier."
>
> - Wade Deal, Ford Motor Company

Processing costs was not an official MAP project metric. However, the savings are undeniable. MAP project companies reported making 50-75% productivity gains. This is consistent with savings reported by companies as large as Ford Motor Company. The absolute savings is dependent upon the number of trading partners with whom a supplier does EDI and the volume of orders from that supplier. Typically, a supplier will do EDI with its largest volume customers. By replacing the manual processes of reviewing, re-keying, and dealing with various problems that arise from key-punch, errors can be conservatively estimated to save eight hours per week. In fact, the savings are likely to be eight hours per week per trading partner. For the sake of remaining conservative, we will use the eight hours per week figure.

Processing cost savings, then, are calculated at a savings of eight man hours, valued at $40/hour, per week at 20,000 points of supply for the "expected" case. The "low" case applies that same level of savings to half the number of firms. The "best" applies the same level of savings to 50% more companies, or 30,000 points of supply. These numbers are conservative for they offer a subset of the total automotive industry.

	Low	Expected	Best
Total Anticipated Savings	**$169 M**	**$ 320 M**	**$ 480 M**

Figure 5-6. Extrapolated Savings in Processing Costs

Total Anticipated Savings

By summing the above listed savings we arise at an expected savings of over one billion dollars annually, broken down as follows:

Savings Type	Low	Expected	Best
Inventory Reduction	**$ 195 M**	**$ 585 M**	**$975 M**
Premium Freight Reduction	**$ 41.25 M**	**$82.5 M**	**$123.75 M**
Unplanned Changeovers	**$ 0**	**$80 M**	**$160 M**
Processing Costs	**$160 M**	**$320 M**	**$480 M**
Total Savings	**$396 M**	**$1,068 M**	**$1,739 M**

Figure 5-7. Total Anticipated Savings

This translates to an expected cost savings of $71.17 per car, using the 15 million cars produced in North America in 1995 as a base.

	Low	Expected	Best
Total Anticipated Savings	$396 M	$1,068 M	$1,739 M
Cost per Car Savings	$26.42	$71.17	$115.92

Figure 5-8. Total Anticipated Cost per Car Savings

The extent of the savings achievable through implementation of MAP type recommendations should not be surprising. The initial analysis of the MAP project team showed that typical supply chains are hampered by waste whose root cause is poor information flow. By focusing on improving the information flow, specifically the time which it takes for information to move through the supply chain, the MAP project team was able to reduce waste in the system.

5.2 Business Case for Individual Company

Ultimately, for such improvements to be adopted throughout the supply chain, individual companies must believe that the required investment of resources generates a positive return on investment. Mandates, such as the recent OEM common EDI requirements will do a great deal to push automotive industry supply chains towards full EDI capability. However, the common requirements become progressively weaker as they move from first to second to third tier.

Further, the MAP experience has shown that suppliers must do more than simply implement EDI, even integrated EDI to reap the full benefits of the technology. Processes must be changed as well. Thousands of automotive industry bottom tier suppliers will remain untouched by the requirements, or required to comply in a weak form. This business case offers a combination of quantitative and qualitative data that validates that individual companies, in particular small companies, receive a positive return on investment from EDI.

The following graphic, based upon MAP Project Final Survey data, supports this case. All respondents strongly agreed that "EDI is an important competitive tool for my company."

The next three datapoints are intended to capture a qualitative measure of whether or not MAP companies felt they received a positive return on investment from EDI. There was disagreement, evidenced by the large standard deviation, among MAP companies as to whether 'rip and read' EDI pays for itself. On average, respondents felt it did not and gave a score of 3.3.

Integrated EDI, is a different story. Respondents felt, to varying degrees, that integrated EDI does indeed pay for itself and gave an average score of 5.8. There was little disagreement among respondents that in order to gain the full benefit of EDI, processes must be changed as well. Note the strong agreement of 6.5 and the small standard deviation.

These results are shown in the following graphic. The circles represent the average score recorded by participants, the thin vertical line represents the standard deviation among scores.

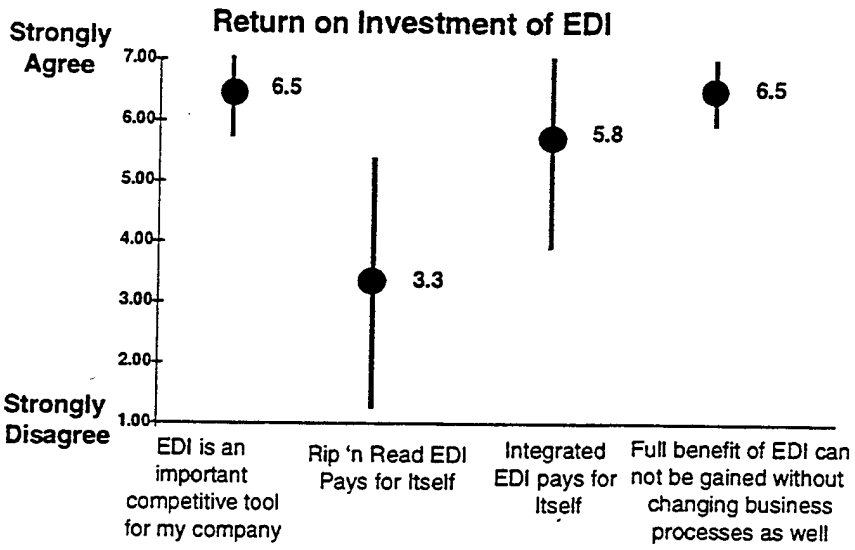

Figure 5-9. Return on Investment of EDI

This section presents a template to help small companies build a business case for making the following MAP type improvements.

- Implement EDI
- Integrate EDI
- Streamline Business Processes

The template focuses on the benefits to a small company of implementing EDI with its customers. The experience of MAP companies has shown that EDI, when implemented properly, generates positive returns. In order to demonstrate that EDI can be a profitable investment for small companies, the words of several bottom-tier MAP participants have been included in this section. Generally, experience has found that the simplest form of EDI, 'rip and read' does not pay for itself. In order for a company to begin seeing a return on EDI investment, it is necessary to integrate EDI into its business systems.

> "Paybacks begin the minute you are able to transmit the information into the computer without human keying. Right at the beginning."
>
> -Bill Conkling, Controller, Specialty Screw
>
> "In a short story, EDI reduces the total assets we have to have in place to support the customer, we can either increase our profitability and viability or we can invest in newer technologies and reduce the price."
>
> - John Mink, President, Rockford Spring

It is important to understand that EDI is an enabling technology, a tool that allows companies to function more efficiently and to do business in new ways. This technology allows you to move information quicker from customer to supplier and, when integrated, within a company. Integrated EDI reduces the errors that come from re-keying data. In general, the underlying business processes contain non-value added steps, multiple hand-offs, delays, and disconnects. To gain the full benefits of EDI it is necessary to redesign business processes.

> "EDI is not a solution or an end in itself In order to accommodate EDI and integrate it into your organization, you have to look at all your procedures, all your processes that relate to the EDI function and, in fact, improve them so that you're not just making things happen quicker that should not have happened to begin with."
>
> - Bob Henneberry, Director of Sales, Rockford Spring

The following pages build the business case template through a systematic discussion of the costs and benefits of implementing integrated EDI. Each cost and benefit is discussed in the following manner:

Nature of the cost/benefit	provides an overview of each cost or benefit.
Cost/Benefit at Company X	offers an example based upon the actual experience of a MAP company.
Calculating Cost/Benefit in Your Company	provides a guide to how to effectively estimate the extent of the cost/benefit in question within your company environment.

In order to guide you through the template, we have included the example of company X, an actual participant from the Manufacturing Assembly Pilot (MAP) Project. In order to maintain confidentiality, the name of the company is not disclosed and slight adjustments have been made to company data.

By proceeding through each cost and benefit systematically, you will gain an understanding of how EDI helped generate positive returns for an actual MAP company, as well as the framework for building a business case for implementing integrated EDI in your own company.

Initial Situation of Company X: No EDI

At the outset of the project, Company X had no EDI connections in place. A major customer had requested EDI connectivity beginning with the Material Release (830) transaction and expanding to include the Ship Notice (856) near the end of the year. Other customers had inquired about EDI communications but not published any requirements.

Company X's internal business applications are part of the existing MIS package. This is an integrated package which runs in the DOS environment and provides modules for order entry, inventory control, accounting, shop scheduling, and shipping. This package is capable of file import/export with EDI translation packages.

Computers are connected to a Local Area Network with one server and five client workstations.

Company X put together a plan for implementing EDI, integrating EDI into the existing business systems, and streamlining business processes. The selected package for EDI communications is capable of file import and export through its use of overlays for transaction sets by trading partner. Each overlay generates a file format which can be used to map data elements to the format necessary for the MIS system to perform import and export operations.

The following actions were taken to implement EDI capability:

- Obtain and install EDI translation software
- Obtain Value Added Network services
- Modify business processes for electronic receipt and transmission of information
- Test and pilot EDI data exchange
- Production EDI with customers

The components of the integration plan include:

- Obtain and install EDI to business application interface software
- Test integrated systems
- Production use of integrated EDI and business applications
- Reengineer business processes

Overview of Costs and Benefits of EDI

The main costs and benefits of implementing integrated EDI are:

Costs	Benefits
Personnel Costs	Decreased Order Processing Costs
Training Costs	Decreased Cost of Errors
Software Costs	Lower Inventory
Hardware Costs	Reduced Spending on Premium Freight
VAN charges	Fewer Unplanned Setups
	Improved Customer Satisfaction

A detailed explanation is presented in the following pages.

5.3 Costs of EDI

In general, the costs of implementing and integrating EDI can be broken down into: Personnel Costs, Training Costs, Software Costs, Hardware Costs, VAN charges. We will address each one of these costs and offer the experience of the MAP participant, Company X, to assist you in calculating the costs of implementing and integrating EDI in your organization.

5.3.1 Cost #1: Personnel Costs

Nature of Personnel Costs

As with any large-scale project, implementing EDI requires the devotion of human resources. Medium to large companies will typically have a support staff of at least one devoted to manage EDI with trading partners; maintain the EDI system; and train employees and trading partners on EDI usage. Small companies will likely utilize existing personnel for this role.

The initial time commitment, and associated cost, of the initial EDI implementation and integration are higher than the ongoing costs once the system is in place.

Personnel Costs at Company X

As a small company, Company X did not hire a EDI coordinator. The responsibility for managing the implementation of EDI and maintaining the system was carried by existing employees.

Initial costs:

Company X personnel devoted a total of seventy man-days to the implementation of EDI and a total of fifty five man-days to the integration of EDI and reengineering of business processes. Valuing employee time at a fully-loaded average of $40 per hour, the opportunity cost of this time is $10,400.

Ongoing costs:

Company X estimates that the ongoing demands of maintaining its EDI system to require one day per week of staff time. This translates to an ongoing, fully-loaded annual cost of $16,000.

Calculating Personnel Costs in Your Company

Most small, bottom tier companies in the MAP project devoted a similar amount of time to implementing EDI, integrating EDI, and reengineering business processes as Company X. These numbers, then, offer a useful guide to the *average* level of personnel costs a small company should expect to bear.

5.3.2 Cost #2: Training Costs

Nature of Training Costs

Training is an essential component of EDI implementation. Training insures that company staff is familiar with and able to efficiently use the EDI software. Further, EDI allows companies to change the way the do business, to redesign processes. Company staff must be trained in the new way of doing business.

Training Costs at Company X

Because the office staff of Company X is quite small, few people were trained in the new system. Company X estimates that three people received the equivalent of three days worth of training. This translates to a cost of $2,880.

Calculating Training Costs in Your Company

Base your estimate of the cost of training upon:

- Number of workers requiring training
- Lost hours from work

5.3.3 Cost #3: Software and Services Costs

Nature of Software and Services Costs

There are three types of software that a company seeking to implement EDI must possess, purchase, or develop internally (it is assumed, for the sake of this discussion, that the company already utilizes an integrated manufacturing information system):

- EDI translation software
- Application interface software
- Communications software

EDI translation software is used to read and interpret incoming EDI data and to send outgoing EDI data. Typically, EDI software is purchased from a specialized software vendor.

Application interface software is the software that enables integration of EDI with a company's business systems. Typically, this software is either purchased from a specialized software vendor or developed internally by MIS staff.

Communications software allows the transfer of EDI information from company to company, generally through a Value Added Network (VAN).

In addition to the costs of the software, custom services are required to install EDI software and perform the integration. The custom programming required to create application interfaces for each EDI transaction set can take 4-8 weeks for the first trading partner and one week for each additional partner.

Implementing and integrating EDI is not a quick process. Most MAP companies required at least five months to move from an EDI-less environment to one with integrated EDI.

The cost of these software packages can vary. Among the small MAP project companies, this range was roughly $2,000 to $10,000 depending on the robustness of the product. Similarly, the cost of custom programming services varies according to the complexity of the programming involved. The small MAP companies paid between $3,000 and $12,000 depending upon the extent of the services provided.

In addition to these costs, annual maintenance fees must be paid to software providers.

Costs of Software and Services at Company X

Company X paid the following for its software and services. Software and programming costs are depreciated over a period of five years.

	Cost	*Depreciate?*	*Adjusted Cost*
EDI translation software	$1,500	Y	$ 300
Additional overlays for MAP customer	$1,000	Y	$ 333
Application interface software	$2,100	Y	$ 420
Custom programming for integration	$3,150	Y	$ 630
Annual software maintenance fee	$ 660	N	$ 660
Total Software and Services	$7,750		$2,343

Calculating Software and Services Costs in Your Company

Utilize the above example as a guideline for calculating the costs of software and services in your company.

5.3.4 Cost #4: Hardware Costs

Nature of Hardware Costs

EDI translation software and integration packages require certain minimum levels of memory to run effectively. For companies with older information systems, it may be necessary to upgrade or replace existing hardware. The hardware requirements of today's EDI packages are not extraordinary.

Hardware Costs at Company X

In order to run the EDI and integration packages effectively, additional RAM and hard drive space was required for Company X's server. RAM was upgraded from 8 to 16 megabytes and the hard drive was upgraded from 500 k to 1.5 megabytes.

The cost of these upgrades was $1,000.

Calculating Hardware Costs in Your Company

Any EDI software vendor can provide you with information regarding the minimum hardware requirements for running its software.

5.3.5 Cost #5: VAN Charges

Nature of VAN charges

VANs charge an initial EDI electronic mailbox charge and a one-time set up charge for the connection to each trading partner's mailbox. In addition, there is a monthly VAN charge, based upon the number of characters in each transaction.

VAN charges at Company X

Company X paid $200 for EDI mailbox and trading partner setup.

Company X pays approximately $100 per month for its VAN charge ($53 flat + $47 variable @ .22/1,000 characters)

Calculating charges in Your Company

Utilize the above information as a guide to the fixed and variable VAN charges. Contact one or more of the major VANs to obtain up-to-date price information.

5.4 Benefits of EDI

The benefits of integrated EDI include:

- Decreased order processing costs
- Decreased cost of errors
- Reduced inventory
- Reduced spending on premium freight
- Fewer unplanned setups
- Decreased lost sales

The following pages offer a more detailed explanation of each benefit.

5.4.1 Benefit #1: Order Processing Cycle Time and Costs Decrease

Nature of benefit:

Integrated EDI enables you to reduce the cycle time of converting an incoming customer material release into an outgoing release to suppliers. The technology allows for business practices to be redesigned and streamlined as well. Orders no longer need to be reviewed on a part number by part number basis. Only the exceptions are now analyzed.

> "We have been able to reduce the time it takes to record customer releases by 75% and we have been able to input the data correctly."
>
> - Russ Johansson, President, Specialty Screw (tier III)
>
> "We have reduced the cycle time of processing in an order in the office and the cycle time of producing an order for the shop. In sum we have reduced our whole lead time by about two weeks."
>
> - Rick Richter, R-R Spring (tier III)

Reductions in order processing cycle time lead to the directly observable decrease in labor costs per processed order. These are the cost savings we will document in this section of the template. It is important to bear in mind that reducing cycle time is also significant because it leads to additional downstream savings:

1. Shorter order processing time increases manufacturing lead time, enabling manufacturers to better schedule their shop and avoid the costs of unplanned changeovers and expediting orders at a premium.
2. Reductions in order processing time allow suppliers to decrease inventory by a corresponding amount (i.e., for a three day reduction in order processing time add three days to the amount of time available to produce a customer order, allowing a three day reduction in inventory on-hand).

Order processing savings at Company X:

Direct labor savings from reducing order processing time were substantial at Company X. Prior to implemented EDI and modifying business processes, order processing was highly labor intensive. Company staff spent 10 hours per week processing releases from its MAP customer. The new process requires only 2 hours of staff time per week, a savings of 8 hours per week and $16,500 per year.

As Company X increases the number of trading partners with whom they do EDI, these savings will grow.

Calculating order processing savings in your company

As indicated, order processing savings can be significant. Based upon the experience of MAP companies, direct order processing costs can be reduced by a minimum of 50-75% for those customers with whom you implement EDI.

As mentioned previously, it will not make economic sense for a small, lower tier company to implement EDI with all customers. For the sake of simplicity, we offer a quick, rough-cut rule of thumb for estimating the extent of potential savings. Typically, it is sensible for a small company to begin implementing EDI with its largest accounts. In most cases, 20% of the customers account for 80% of a supplier's business. Similarly, these same 20% of the customers will consume 80% of the total resources for processing orders.

Calculate CP: the direct cost of processing customer orders for your largest customers

Typically it is better to begin from the total amount of resources (i.e., salary + benefits + overhead) spent on processing all customer orders. Work backwards to the cost of processing the orders of your largest customers by estimating the percentage of resources that servicing these customers consumes. If you require a high level of precision in your calculation, you will want to spend time observing the process and gathering actual data. If a rough-cut estimate is sufficient for your purposes, you can generally assume that 80% of your resources are being devoted to servicing your main customers.

CP = direct cost of processing orders for your largest customers

Calculate SP: the amount of direct labor savings that implementing integrated EDI and/or streamlined business processes will result in.

MAP companies report reducing cycle time by 50-75% and gaining proportional cost savings. Without integrated EDI, your order entry process is likely to be highly labor intensive and highly inefficient. Integrated EDI allows you to avoid the timely process or re-keying data and the timely review of each part number and focus, instead, on exceptions only. Again, depending upon the level of precision that you require there are two ways to come up with an approximation of the savings.

SP = .5 * CP or

SP = Σ (savings per customer with whom you will do EDI)

5.4.2 Benefit #2: Error Rates Decrease

Nature of benefit:

Once EDI is integrated into a company's business systems, the need for re-keying data goes away. Typically, re-keying data has an error rate of 10-15%[10] MAP companies reported, on average, error rates of 3% after integrating EDI, a 72% improvement. Studies have found that it costs 10 to 15 times as much to correct an ordering mistake as it does to process an accurate order.[11]

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[10] MAP Project Final Survey Results, *Final Evaluation Report*, Cooperative Agreement Number: F33615-95-2-5518 Article 15A.#8. Consistent with industry findings.

[11] The Gartner Group: Evans-Correia, K.,"EDI: the Future Frontier," Purchasing, February 1989. pp. 44-49

Reduced error rates at Company X:

After integrating EDI into its business systems, Company X reduced the percentage of errors from 10% to 3%, a reduction of 70%. Key punch errors lead to problems that consume the time of workers and managers alike. Managers at Company X estimate that the value of the amount of time spent by all workers on problems arising from keypunch errors for its MAP customer is worth roughly $5,000 per year.

As Company X increases the number of trading partners with whom they do EDI, these savings will grow.

Calculating value of reduction in error rates at your company

As mentioned above, studies suggest that it costs ten to fifteen times as much to correct an ordering mistake as it does to process an accurate order.[12] This figure encapsulates all downstream time spent by workers and managers doing work that is not value added (as a result of false data), and identifying and rectifying particular problems. We offer two methods of computing the cost of errors in your company. As always, be sure to compute cost savings based upon the number or percentage of customers with whom you will implement EDI. We offer two methods of computation.

Method One: Extrapolate the cost of errors based upon your order processing costs.

- Calculate your cost per order (Total processing costs/ number of orders)
- Estimate the cost per erroneous order

  Typically this is 10-15 times the cost per order
- Calculate the number of erroneous orders

  This is the cost per order times the number of erroneous orders. If you process 10,000 orders annually and have a 10% error rate, you have 1,000 erroneous orders
- Calculate the total cost of all erroneous orders

  This is cost per erroneous order x number of erroneous orders
- Calculate the savings from 50-75% reduced error rates

Method Two: Conduct a detailed observation and analysis of the actual amount and value of time and resources that are spent reacting to, identifying, and solving problems that arise from key-punch errors. This is a significantly more time-consuming effort than utilizing the simple rule-or-thumb offered above.

5.4.3 Benefit #3: Inventory is Reduced

Nature of benefit:

Suppliers hold inventory to hedge against the risk of the unknown. It is a form of waste that can be removed from the system. A customer receive no value from a pile of springs, screws, or seats on a factory floor or in a warehouse. By gaining better information and the ability to react quicker, companies are able to trade information for inventory. This is significant because holding inventory is expensive. It ties up capital that could be invested elsewhere, and necessitates the bearing of inventory carrying costs, which tend to increase or decrease in proportion to inventory levels. Thus, reducing inventory levels has two favorable effects:

1. Improved cash flow
2. Reduced cost

Carrying costs of inventory tend to average 25% of total inventory levels. These costs are made up the cost of capital, handling, space, and obsolescence. To calculate the cost savings of a decrease in inventory, one can use the 25% as a proxy with a reasonable degree of confidence.

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[12] The Gartner Group: Evans-Correia, K.,"EDI: the Future Frontier," Purchasing, February 1989, pp. 44-49

Inventory reductions at Company X

Following the implementation of EDI and improved processes, Company X was able to meet the demands of their MAP customer while carrying significantly less inventory. Inventory turns for MAP parts more than doubled from an average of 8 prior to implementation to 19 in the last two months of the pilot. This increase represents an inventory decrease of 58% on a constant sales basis. It should be noted that the dramatic improvement in inventory turnover performance is due, in large part, to modified business processes related to the scheduling of shop floor production. The annual value of this savings is:

- Reduction in average inventory levels for MAP customer: $15,000
- Net Savings (25%): $ 3,750

Company X has identified $3,000,000 in sales volume from the major customers with whom it is likely to implement EDI. The associated inventory being held prior to implementation was $375,000. The doubling in inventory turns experienced by Company X is remarkable, and due in large part to process changes in production scheduling that have already begun to take effect on inventory levels for all customers. When estimating the impact of Company X implementing EDI with it's largest customers, it would not be conservative to project this trend outwards. We will use, then, an improvement one half as strong. Thus, if inventory turns increase from 8 to 14 (as opposed to from 8 to 19 as experienced with the MAP customer) Company X can expect their average inventory level to fall to approximately $230,000. This is a $145,000 decrease in average inventory levels, which translates to a net annual savings for Company X of this reduction or $36,250.

Calculating inventory reductions in your Company

To calculate the potential savings due to a reduction in inventory levels, first determine the quantity of inventory that they have on hand that corresponds to those customers that you have targeted as key trading partners with whom you plan to implement EDI. Through EDI implementation and integration, inventory levels can expected to decrease by 10%. Why is this?

Reduced order processing cycle time increases internal production lead times, increasing a company's ability to react to customer demand and allowing the maintenance of lower levels of finished goods inventory.

Improved information from customers via EDI and lower error rates in order entry reduce the need to hedge information risk by building inventories.

Larger inventory decreases have been seen throughout the pilot, yet 10% stands as a conservative average of all companies. Greater gains can be expected to be achieved through process changes, particularly for companies with sub-optimal order entry, scheduling, and inventory control processes. For example, the improved information flow from EDI often enable large batch producers to cut the size of their production runs by up to one half, gaining a 50% reduction in work in process inventory.

We offer two methods of estimating the size and value of anticipated inventory reductions at your company. As previously, method one is more time consuming and slightly more complex. Method two offers a quick, rule-of-thumb estimate based upon the experience of MAP companies.

Method 1: Calculate inventory reduction based upon cycle time reduction estimates and expected reductions in batch size.

Every day of order processing cycle time reduction should correspond to a one day reduction in inventory. Quite simply, you were maintaining that extra day's worth of inventory previously because you lacked information.

- Calculate the average number of days worth of inventory you currently maintain and the value per day (Example: 30 days valued at $100,000 per day)
- Estimate the number of days by which you expect to reduce order processing cycle time. (Example: 4)

- Calculate the value of the inventory reduction (4 days at $100,000 per day = $400,000).
- Take 25% of the inventory reduction to calculate annual net savings ($100,000)

Method 2: Assume 10% inventory reduction. Calculate annual net savings at 25% of the value of inventory reduction.

5.4.4 Benefit #4: Spending on Premium Freight is Reduced

Nature of benefit

When information on orders arrives late, available lead time is reduced and suppliers often have to pay premium freight to deliver their product. This cost is either absorbed by the supplier or passed on to the customer. In either case, it is a form of waste that is avoidable through better information. Implementation of EDI has enabled many suppliers to reduce spending on premium freight. Milliken reported significant reductions in premium freight as a result of receiving order information via EDI from its customer and implementing new, improved inter-company business practices. MAP participants generally report that implementing EDI with more suppliers would lead to reductions in premium freight.

> "We feel that if we had better information that would lead to about a ninety percent savings right there."
>
> - Russ Johansson, President, Specialty Screw (tier III)

Within the MAP project savings on premium freight varied from company to company. The variance can be attributed, in general, to the historic level of premium freight between each MAP customer-supplier pair. High levels of historic spending signal significant opportunity for improvement and cost savings. Low levels of historic spending to expedite goods to a particular customer imply that premium freight reductions may not be one of major benefits gained from EDI implementation. Thus, each customer-supplier pair should be considered independently.

Premium freight reductions at Company X

Within the MAP project, Company X had little premium freight expense before or after implementation of EDI due to its geographical proximity to its primary project trading partner. However, among other potential trading partners, Company X has approximately $20,000 in premium freight expense. They feel that the improved information flow gained through EDI with these additional trading partners, has the potential to reduced spending on premium freight by 25% or $5,000 annually.

Calculating premium freight benefit in your Company

As mentioned above, the degree of savings on premium freight will vary from customer to customer. We offer the following methods of calculating the anticipated value of such savings in your company.

Method 1: Estimate the annual dollar value spent on premium freight to expedite materials to your major customers, with whom you are likely to implement EDI. Assume a 10% reduction.

Method 2: Conduct a more detailed analysis that identifies the percentage of spending on premium freight that is due to late or inaccurate order information. In theory, EDI implementation has the potential to eliminate all such spending. In reality, a 30-50% reduction of this amount should be achievable.

Although savings have been known to vary, companies can consider a savings of 10% on their premium freight expense to be modest. For the business case worksheet, simply multiply the entire premium freight expense that pertains to your potential trading partners and multiply by 10%.

5.4.5 Benefit #5: Fewer Unplanned Set-ups and Changeovers

Nature of benefit

Unplanned changeovers are caused by suppliers receiving late information concerning changes in demand. As a result of the production schedule adjustment, production runs are broken, valuable production time is lost, quality is reduced, and labor time is consumed in tearing down the old set up and preparing the new. These unplanned changeovers add cost to the system. Many of the costs of such changeovers occur downstream and are not always captured by a company's accounting system. For example, a supplier breaks a production run to do a priority run for customer A. As a result of this schedule change, customer B's product is pushed further back in the queue. Ultimately, the supplier is unable to deliver customer B's product on-time, damaging its reputation for customer service. Such actions have consequences and costs that are not always directly observable, but costly nonetheless.

Unplanned changeovers at Company X

Company X lacked sufficient systems to accurately track the number and cost of unplanned changeovers. Company X estimates that EDI links with its customer will result in the elimination of at least two unplanned changeovers per year, valued at $1,000 per changeover.

Calculating value of reduction in unplanned changeover in your Company

The extent of the reduction in unplanned changeovers in your company will depend largely upon your production environment. Extremely flexible manufacturing, JIT systems experience relatively little to no changeover costs. Large batch manufacturers whose production processes whose changeovers and setups may take eight hours or more stand to gain the most.

To calculate the savings:

- Establish the cost per unplanned changeover.
- Be sure to include all direct and downstream costs of the changeover:

  direct labor costs

  cost of quality

  cost of lost productive capacity

  indirect, downstream labor costs.

Estimate the number of unplanned changeovers that you anticipate will be avoided due to improved information from your customers.

As mentioned previously, this quantity will vary from company. In a batch environment, it is conservative to anticipate that a minimum of two unplanned changeovers per year will be avoided through the implementation of improved communications via EDI and improved inter-company processes with key customers.

Multiply the two numbers together to calculate the total savings.

5.4.6 Benefit #6: Improved ability to provide customer service

Customer satisfaction is an intangible benefit that can not be ignored. MAP companies report that linking electronically with their customers has improved their ability to service that customer. Similarly, MAP customers report receiving improved customer service from their suppliers after implementing EDI with

them.[13] By implementing EDI and streamlining business practices, suppliers gain the ability to react quicker to changes in demand and better service their customer.

> "We have been more competitive by virtue of being able to respond to our customers' needs, instead of just saying 'no we can't do that here' we're now able to say 'yes we can do that, how do you want it?"
>
> - Deb Humeniak, Manager MIS, Rockford Spring (tier III)

In addition to being able to providing improved service to existing customers, EDI has become a valuable marketing tool for several MAP companies. With the rapid growth of EDI implementations throughout the automotive and other industries, EDI is quickly becoming a requirement for doing business with Fortune 500 customers. Several MAP companies have reported that their EDI capability has led to new sales that they would not have otherwise received.

> "We were in a meeting with a major customer with another spring company. When the question came down as to whether we were EDI capable, we were and they weren't. We got the business and they didn't"
>
> Ron Richter, owner, R-R Spring (tier III)

Improved customer service at Company X

Company X has been able to provide better service to their MAP customer as a result of implementing EDI with them. While these benefits are difficult to quantify, it is not difficult to quantify what the costs of losing this customer would be. We do not include this cost in our template, as it would not be reasonable to assume that without having implemented EDI Company X would lose its customer. However, it is important to bear the costly risk, no matter how small, in mind.

Alternatively, Company X has experienced very tangible benefits through using its EDI capability to capture new business that it would not have otherwise received. For this reason, it is important to include all profits from such business in our template. The total profit from this business is anticipated to be $30,000 this year.

Calculating the value of increased customer satisfaction in your company

To calculate the value of increased customer satisfaction in your company due to EDI, be sure to consider its two forms: the value of a satisfied customer, and the value of sales that you would not receive without being EDI capable. For the first, think carefully about how much it is worth to you to provide better, faster, more reliable service to your key customers. Alternatively, think about how much it would cost you to lose them. After all, if you do not provide these services you can rest assured that somebody else will.

The best way to estimate how much new sales EDI can help your sales staff generate is to talk directly with your sales staff. How many customers are asking if you are EDI capable? How often do you lose bids to these customers? Why do you lose bids? As with previous cost categories, it is possible to invest a large amount of time and money into formulating an accurate estimation. It may be that a rough 'order of magnitude' estimate based upon the intuition of your best salespeople will be enough to help you come up with a reasonable dollar figure.

5.5 Business Case for Company X

The following table displays Company X's costs and benefits of implementing integrated EDI and streamlined business practices as detailed in the previous section. It is important to bear in mind that these

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[13] MAP Project Final Survey Results, *Final Evaluation Report*, Cooperative Agreement Number: F33615-95-2-5518 Article 15A,#8.

costs and benefits reflect EDI implementation with one customer. The extent of benefits will be greater when Company X begins to connect via EDI with its remaining key customers.

Costs

Personnel Costs	$ 10,400
Training Costs	$ 2,880
Software and Services Costs	$ 2,343
Hardware Costs	$ 1,000
VAN charges	$ 1,400
Total Costs	$ 18,023

Benefits

Fewer Errors	$ 5,000
Productivity improvements	$ 16,500
Inventory savings	$ 3,750
Premium freight savings	$ -
Unplanned setups	$ -
Customer satisfaction	$ 30,000
Total Benefits	$ 55,250

6. Technology Transfer

6.1 Generalizations to Aid Other Industries

The benefits gained within the MAP chain, and anticipated within the automotive industry, can be achieved in other manufacturing industries as well. As other industries move to implement MAP project-type recommendations in efforts to take waste out of their supply chains, there are certain lessons learned from the MAP project that should be followed. Most of the applicable lessons exist at the industry level and include the establishment of an industry standard bearer to promote and oversee project implementation, clear and specific recommendations for individual companies, and exact standards that will exist throughout the industry. Each individual company should understand the importance of having executive level support for project implementation, establishing a project manager, and fully following the recommendations set forth for the industry. Material and information flow improvement efforts rely upon the complete cooperation and initiative of all companies within a supply chain or industry. Incomplete efforts invariably decrease the effectiveness of the projects recommendations and have detrimental effects upon the ultimate success of the project and its proponents.

At the industry-level, the importance of having an organization or industry association that can facilitate the evolution of industry-wide increased competitiveness. For the MAP project, this role was performed by the Automotive Industry Action Group, who sponsored and managed the project. The AIAG has a membership of 1,300 OEM and supplier companies, who meet each month to identify, discuss and work to resolve common issues. The AIAG is chartered with improving the global productivity of its members and the North American Automotive industry by providing an organization to:

- Foster cooperation and communication between trading partners to improve and reduce variation in business processes and practices.
- Address existing and emerging common issues and apply new and current technology to increase the efficiency of the automotive industry.
- Promote a sense of urgency in adopting developed business processes.

The AIAG was instrumental in recognizing the competitive significance of conducting a supply chain reengineering effort and generating a coalition of support for such a large-scale undertaking. A key lesson to be taken from the MAP project, is the importance of conducting a pilot project, validating the results, and then possessing a plan for the industry wide adoption of project recommendations. From the start, the MAP project has been focused on identifying tangible practices that can be implemented in supply chains to make measurable improvements in competitiveness.

The MAP project has already begun to have this impact. On March 11, 1996 Ford, GM, and Chrysler issued a letter outlining a common set of Electronic Data Interchange (EDI) requirements that extend to the third tier. The joint policy grew out of the Big 3's involvement in the AIAG's Manufacturing Assembly Pilot (MAP) project and is one of the strongest signals that the change to a more flexible automotive supply chain is underway.

In addition to guiding OEM EDI policy , the MAP project has provided another valuable service. The project is a model for engineering systemic solutions to industry problems that incorporate the complexities and idiosyncrasies of multi-tiered supply chains. The pilot methodology and approach to industry adoption provide a proven mechanism for identifying, testing and then scaling out best practices industry wide. This is a new way of driving industry change, and it is no small accomplishment.

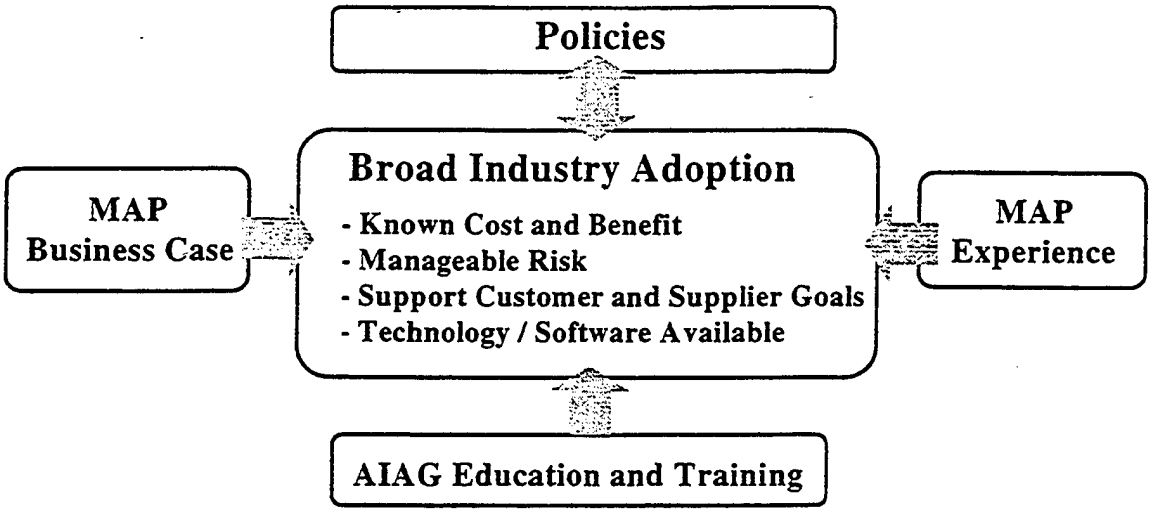

Figure 6-1. Model for Industry Adoption

MAP is succeeding in its goal of improving supply chain agility because of the solid foundation on which the project's approach to industry adoption is built. The MAP experience created recommendations based upon the opinions, experiences, and input of suppliers from four tiers and two chains, hardware and trim. Small, lower tier suppliers sat at the same table as Chrysler, Ford, and GM and were able to make their voices heard. The MAP business case rises from the experiences of these same suppliers, who implemented and measured the effects of their new practices. The business case shows that such implementations can be made profitably, with known cost, benefit, and risk at all levels of a supply chain. OEM policy is facilitating industry change, by mandating common EDI requirements down through the third tier. Finally, the AIAG offers training and resources for suppliers seeking guidance on *how* to best implement EDI and process changes.

6.2 Discussion of Implementation Schedule

The adoption of the MAP recommendations is being supported by a coordinated set of activities designed to promote benefits and break through barriers. These activities leverage an on-going process at the AIAG to support industry wide improvements. Now the MAP recommendations have become the recommendations of the automotive industry. Promotion of these recommendations will continue even when the MAP project has been completed.

The efforts to promote the benefits and break through the barriers, include:

- The MAP project, as an improvement process
- Business case based on metrics
- Implementation experience
- Conferences
- Major customer support
- Training and Publications
- Vendor involvement

The adoption of the recommendations is facilitated by the process MAP used to develop them. Rather than a top-down approach, where customers would determine what their suppliers should do, MAP used a collaborative process where all tiers worked together toward a common goal. Top-down solutions do not always work and are not always appropriate for sub-tier suppliers. By working together, from the very beginning, recommendations were developed that fit the needs of the whole supply base.

The objective of MAP is to determine the root cause of an industry wide problem (speed of information flow down the supply chain), and kick-off broad deployment of the solution. The plan used a set of 16 companies, in 4 tiers of the seating supply chain, as a sample of the industry as a whole. These suppliers, working together, identified solutions, implemented them, and monitored the results. Part of the success of MAP is the companies that participated in the pilot. Automotive seating is widely viewed as a complex supply chain. The suppliers that participated ranged in size from 37 to several hundred employees. As such, the results of MAP have great credibility in the industry. More importantly, an individual supplier is able to identify with a MAP participant, and say "if it works for them, it can work for me".

During MAP the participants developed a set of metrics to measure the impact of the improvements. The metrics were established with two objectives. First, the metrics were selected to validate that the recommended improvements were having the desired impact. Second, the metrics were selected to build a business case for adoption. It was a very practical approach, by design. The metrics were set up to support broad deployment of high impact improvements. The metrics effort tracked key business parameters before and after adoption of the recommendations. As a result of these metrics, a strong business case exists for implementing the recommendations at a firm and supporting the implementation at a firm's suppliers.

The business case justifies the implementation from both a cost/benefit and strategic point of view. The primary audience for the business case is the manager at a supplier that has yet to implement the recommendations. The intent is to convince that manager that it is in their own best interest to make the improvements. That decision, however, is greatly influenced by the viewpoint of their customer. As such, a business case has also been developed to convince a higher tier supplier that it is in their collective interest to have their suppliers implement the recommendations.

During MAP, we gained implementation experience that is being shared. Implementation assistance was provided to the participating firms. Where possible, common approaches were used to reduce cost and effort. As a result, we have implementation plans, best practice guidelines, understanding of cost and timing, and other lessons learned that are being used by others as they implement these technologies. Also coming out of this experience are case studies from the firms themselves. The case studies describe what improvements were made, the resources used, and the benefits realized.

From the beginning, the MAP project has shared progress with the industry using publications and conferences. In this way, the industry has come to learn about MAP and expect results. The MAP project has understood the need to communicate the MAP message to multiple levels within firms. Some presentations speak to the strategic needs of upper management while others explain implementation technicalities to materials management staff. Finally, MAP produced a video to promote implementation of the recommendations. This video will be distributed to over 10,000 firms.

A major accomplishment was realized when Chrysler, General Motors, and Ford jointly agreed to require the use of EDI, down the supply chain, as recommended by MAP. At this point the industry leaders had taken on the results of MAP for themselves. They issued letters to their supply base stating the requirements with a timetable. The letter made it clear to suppliers that implementing the MAP recommendations was strategically aligned with the direction of their customer and the industry as a whole.

The AIAG additionally supports implementation of the MAP recommendations through training, publications, and work groups. The training helps companies understand how to adopt EDI with their suppliers and customers using common methods. The publications support the training and provide references to the common solutions, and technical details, used in the transaction sets. Work groups provide a forum where problems can be identified and resolved.

6.2.1 Show Stoppers

This section describes issues that could prevent deployment.

Manufacturing Software

Adoption of integrated EDI depends on establishing close interfaces between the manufacturing software and EDI software. As such, implementation of integrated EDI requires changes in manufacturing software. As stated earlier, there are many manufacturing software vendors. These vendors are often small firms with

limited resources. If the manufacturing software vendors are slow to make changes to integrate EDI functions, the rate of industry adoption will also be slowed.

Manufacturing software vendors have two approaches to provide EDI solutions. It is a basic make-buy issue. They can either build EDI solutions into their existing product or interface to an existing EDI software solution. Unfortunately, there is a tendency with software vendors to underestimate the effort required for something new. The result is that most manufacturing software vendors are building, rather than buying EDI solutions. We should expect that the resulting EDI solutions will be slow in arriving.

Suppliers are not likely to change manufacturing software vendors, to get EDI functionality. Because the manufacturing software is such an integral part of a suppliers business, there is great resistance to changing providers. Changing manufacturing software vendors is expensive and traumatic to an organization.

Industry Follow-through

It is critical that the industry follow-through with its stated requirements for EDI implementation. Suppliers need to hear a consistent message that implementing EDI is important. The industry can do this by including EDI implementation in supplier evaluations and supplier development meetings. This message must be repeated for the several years it will take before wide-spread EDI adoption. It needs to be presented as the normal and expected way to transact business.

Industry follow-through will be more difficult at lower tiers in the supply chain. At these levels, there is seldom a formal supplier evaluation process or supplier communication process. There is a trend, however, to build these supply chain management systems below the OEMs.

6.2.2 Need Areas Not Now Being Addressed

There are no programs in place to monitor, modify, or extend the MAP recommendations. As the MAP recommendations are implemented in the thousands of firms affected, it is certain that problems will be come up. These problems could relate to the levels of implementation, the implementation effort itself, or the overall supply chain impact of implementation. Resolving this issue would require tracking systems, analysis of results, determination of required adjustments, and deployment of those changes. This on-going tracking would need to continue for several years, while the supply chain adopts the MAP recommendations.

6.3 Deployment in Other Industries

There are no programs in place to leverage the results of MAP within other industries. The automotive industry is recognized as a leader in materials management. As such, other industries will try to emulate the success of MAP in auto, but they have no programs to pick-up the results of MAP and apply them.

6.4 Target Companies and Industries that Could Benefit from Results

Automotive and Automotive Equipment Industries

Listing of Associations

- Association of International Automobile Manufacturers, Arlington, VA
- Japan Automobile Manufacturers Association, Washington, DC
- Motor Vehicle Manufacturers Association Of the United States, Detroit, MI
- Association of Automotive Aftermarket Distributors, Memphis, TN
- Automotive Body Parts Association, Houston, TX
- Automotive Parts and Accessories Association, Latham, MD

- Automotive Parts Rebuilders Association, McLean, VA
- Motor and Equipment Manufacturers Association, Englewood Cliffs, NJ

Aerospace Industry

Top 10 Manufacturers

Boeing Company	$21,924M
McDonnell Douglas	$13,176M
Textron Inc.	$9,683M
Northrop Grumman	$6,711M
General Dynamics	$3,187M
Lockheed Martin Aeronautical	$2,329M
Sikorsky Aircraft	$2,300M
Kaman Corp.	$821M
Cessna Aircraft	$810M

Aircraft Engines and Engine Parts

GE Aircraft Engines	$6,580M
Allied Signal Aerospace	$6,000M
Pratt and Whitney	$5,900M
Teledyne, Inc.	$2,492M
SCI Systems Inc.	$1,853M
Rohr, Inc.	$918M
Chromalloy Gas Turbine	$713M
Textron Lycoming	$670M
Parker Bertea	$635M
Allison Engine	$580M

Aircraft Parts and Equipment

Sundstrand Corp	$1,373M
Coltec Industries	$1,327M
BF Goodrich Aerospace Div	$1,000M
Lucas Aerospace Inc.	$825M
Fairchild Corp.	$464M
Textron Aerostructures	$265M
BE Aerospace Inc.	$229M
Convair	$190M
Kaman Aerospace Corp.	$175M
Loral Electro-Optical	$130M

Electric Equipment Industry

Associations

- Electrical Apparatus Service Association, St. Louis, MO
- Electrical Generating Systems Association, Coral Springs, FL
- International Coil Winding Association, Imperial Beach, CA
- National Association of Electrical Distributors, Wilson, CT
- National Electric Manufacturers Association, Washington, DC

SIC 367X Companies over $500M

3671 Electron Tubes	
Varian Associates	$1,553M
3672 Printed Circuit Boards	
Solectron Corp.	$1,457M
3674 Semiconductors and Related Devices	
Intel Corp.	$11,521M
Texas Instruments	$10.315M
Siemens Corp.	$7,300M
National Semiconductor Corp.	$2,014M
Micron Technology Inc.	$1,629M
Analog Devices	$774M
LSI Logic Corp.	$655M
Harris Semiconductor	$638M
VLSI Technology Inc.	$587M
Cirrus Logic Inc.	$544M
Fujitsu Microelectronics Inc.	$544M
Amkor Electronics Inc.	$500M
3678 Electronic Connectors	
AMP Inc.	$4,028M
Thomas and Betts Corp.	1,076M
Molex Inc.	$964M
Amphenol Corp.	$693M
3679 Electronic Components	
Harris Corp	$3,336M
General Instrument Corp.	$2,036M
SCI Systems Inc.	$1,853M
ITT Defense and Electronics Inc.	$1,710M
Read-Rite Corp.	$639M
Andrew Corp.	$558M
Augat Inc.	$530M

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8. Appendixes

8.1 Appendix A: E-mail Plan Template

<Company>, E-Mail Implementation Plan

E-mail Team:

<Company Representative> (Project Manager)

<Field Agent>, <ECRC/MEP> (Field Agent Role)

<Consultant>, <Consultant> Systems (Services Provided)

<Vendor Technical Rep>, <Vendor> (Product Description)

Objective:

[This section contains a brief statement of the overall objective of the plan.]

EXAMPLE:

The e-mail objective at <Company> is to use the existing Novell Netware environment and UNIX e-mail system to provide a dual environment for external communication while enhancing the internal system with a more feature rich, user friendly interface.

Current Situation:

[This section describes the current level of the current computer environment(both hardware and application systems) and E-MAIL activity within the company. It should include a statement of the requests that the firms had for E-MAIL trading.]

EXAMPLE:

<Company> currently use UNIX Mail for internal e-mail. This runs on a Unisys Pentium based server. Approximately 80% of the front-office staff use e-mail regularly. The user community consists of 40+ personal computers running on a Novell Netware 3.12 network. In addition, there are 12 terminals attached to the server using FacetTerm, a software product that allows the use of multiple windows on a UNIX connected dumb terminal. CONCERT SPC specialized 286 personal computers are on used on the shop floor for gathering quality information. These have a special keypad but can have a standard keyboard attached if desired. At this time they are not used for any e-mail.

Plan:

[This section gives a description of the planned E-MAIL implementation with a bullet list of major activities and a gannt chart of the high level tasks from the Detail Task Description Section.]

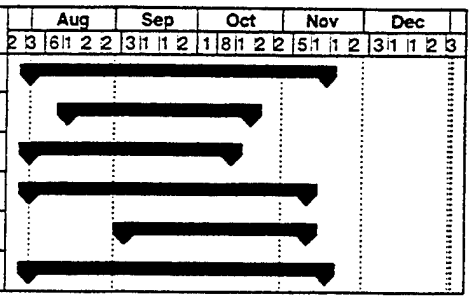
EXAMPLE:

<Company> can capitalize on its staff willingness to use e-mail by developing a messaging environment that is easier to use and has a larger number of capabilities. Since a high percentage of the staff is computer literate they are ready to expand their use of e-mail into areas having more direct impact on business processes. For example, spreadsheets are used by many individuals in their daily work. By introducing an e-mail system that has the capability to have spreadsheet files attached to the message, users can share information in a more efficient manner. Design CAD files could also be attached in a similar manner that will allow the movement of these files electronically.

The introduction of external e-mail will facilitate communication not only with customers and suppliers but also with the various sales representatives and brokers. This capability will allow for a more rapid turn around in special quote and order processing as well as allowing for queries on existing orders and shipments.

The plan is an example of the major tasks and timetable.

ID	Task Name	Task	CO.	MEP	CON
8	Implement E-mail	2	44.25	8.75	18.25
9	Acquire HW SW Services	2.1	6	0	0
13	Modify Business Processes	2.2	19	0	10.5
22	Testing	2.3	4.5	4	0.5
28	On-Going Support	2.4	10	2	3
34	Project Management	2.5	4.75	2.75	4.25



Benefits / Cost Analysis:

[This section contains a text statement of the Benefit/Cost Analysis and a table showing the dollar amounts to be spent plus the required staff times of the participating companies to complete the project.]

EXAMPLE:

It is expected that external e-mail will improve communications with customers and suppliers. This improved communications should enable greater responsiveness. By introducing a more user friendly e-mail environment, internal use of e-mail will grow. Work will be completed sooner and problems resolved faster. E-mail will allow staff members to communicate internally and externally in a more effective manner.

Current use of internal e-mail has introduced the advantages of the technology into <Company>. With the new environment more complex business processes can be adopted that utilize e-mail as an enabling technology. Expected examples of this expanded use of internal e-mail will allow for the distribution of production and shipping schedule changes and inquiries in an orderly fashion. Quotes and proposals can be generated and reviewed by the required individuals without the cumbersome process of copying and distributing paper.

External e-mail will be the method by which Supplemental Communications will be received from <Company B>, as part of the project. These Supplemental Communications will identify unusually large changes in material requirements such as confirming or modifying schedules and quantities. E-mail will also provide a mechanism for informal inquiries on parts availability and pricing, help resolve quality issues and develop a greater feeling of involvement of the companies as true partners.

Potential e-mail trading partners include project participant <Company B> and non-project companies Allied Signal, Eaton, General Electric (several divisions), General Seating, McCullugh, Parker-Hannifin, Regal Plastics, Sears, Tecumseh Engine, TRW, United Technologies, and Whirlpool.

External e-mail capability is valued by customers. As such, addition of e-mail capability should help differentiate <Company> within the market.

Adoption of this plan will have the following cost:

E-mail Costs	Initial	On-going
Purchased Equipment, Software, and Services	$750.00	$75.00 per month
Internal Staff Time	44.25 days	1 day per month
<ECRC/MEP> Staff Time	8.75 days	N/A

<Consultant> Staff Time	18.25 days	N/A

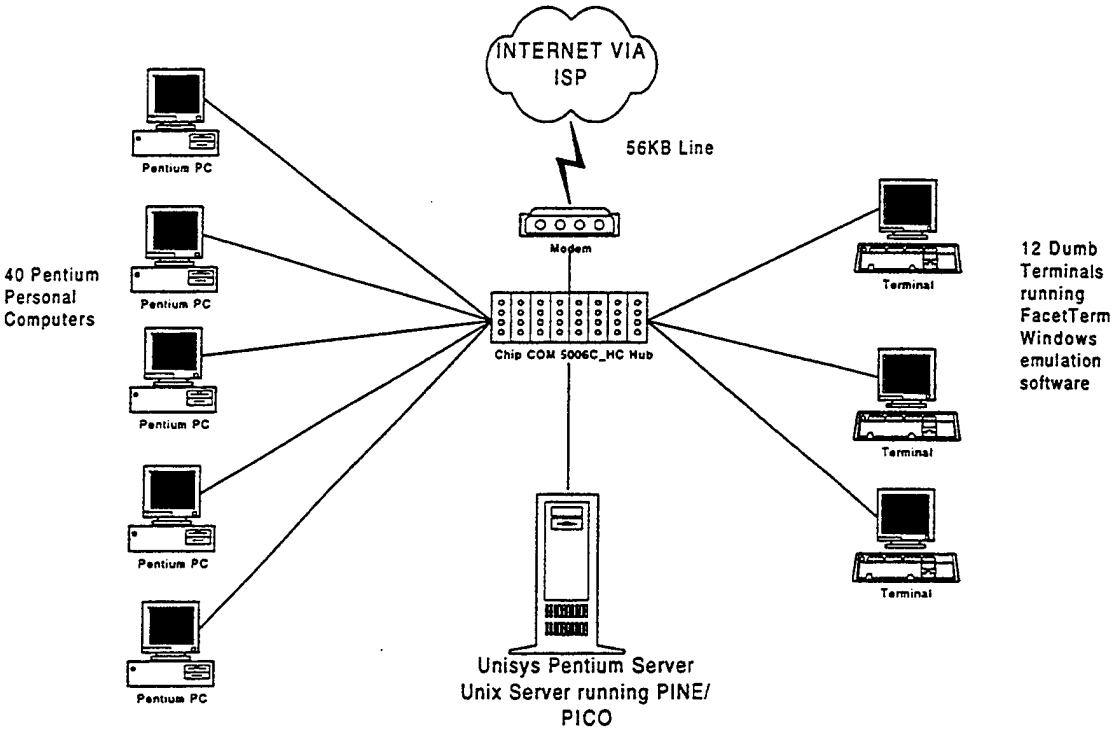
Acceptance of this plan will be based on a strategic business advantage rather than a direct financial return on investment. Return on investment justification was not used because the financial benefits of e-mail are difficult to quantify.

Block Diagram:

[This is a simple graphical representation of the E-MAIL configuration and flow described in the plan.]

EXAMPLE:

<Company> Propsed E-mail Configuration



Configuration:

[This section provides a brief text statement of the planned E-MAIL implementation.]

EXAMPLE:

It is recommended that <Company> install Pine/ Pico as the primary user e-mail system. This product will be compatible with the current use of Word Perfect for word processing and QuatroPro for spreadsheet applications as well as the current Novell Netware environment. This will provide Specialty with an integrated suite environment strongly leveraging the existing knowledge of the user community.

Since <Company> has a UNIX server, it is recommended that direct external Internet service be introduced as a secondary means of e-mail communication. This capability should include MIME implementation to

provide the most robust e-mail environment possible. The external Internet connection would be provided by a commercial Internet Service Provider (ISP) such as Ameritech, MCI or SprintNet. (Investigation of this service for the area is still underway.)

Detail Task Descriptions:

[This section provides a listing of all the detail tasks required to complete an E-MAIL Plan for a UNIX environment. Each subtask contains a Description of the task plus a Rationale or justification for the activity and the Required Effort for those parties executing the particular subtask. The example below contains the most common tasks for such an effort. However, individual tasks will change for a given specific implementation. For example, a cc:Mail implementation would install the cc:Mail package instead of PINE, the cc:Mail gateway product would have to be installed to connect to outside e-mail services, etc. Additional tasks may be required for any specific implementation of E-MAIL.]

TASK 1.0 ACQUIRE HARDWARE, SOFTWARE AND SERVICES

SUBTASK 1.1 SELECT INTERNET SERVICE PROVIDER (ISP)

Description: Select the preferred vendor for Internet connectivity.

Rationale: Selection of a local ISP will provide direct connectivity to the Internet. This will provide a low cost back-up to the GEIS VAN and leverages the current UNIX environment.

Required Effort: Internal Staff: 3 days

SUBTASK 1.2 INSTALL DIRECT INTERNET CONNECTION

Description: Vendor of choice will install Internet connection and test with the <ECRC/MEP> CEC Testbed.

Rationale: Internet access will provide the most economical external e-mail interface. This connection will provide e-mail communication to other project firms and provide <Company> with the capability to receive the large scale change for releases.

Required Effort: Internal Staff: 1 day

SUBTASK 1.3 INSTALL PINE/ PICO E-MAIL APPLICATION

Description: Add MIME to UNIX e-mail capabilities.

Rationale: The addition of a MIME compliant e-mail reader will provide the capability to exchange various types of documents across the Internet. These include attached binary files and E-MAIL transactions as recently defined by the Internet Engineering Task Force.

Required Effort: Internal Staff: 2 days

TASK 2.0 MODIFY BUSINESS PROCESSES

SUBTASK 2.1 DEVELOP PROCESSES TO HANDLE E-MAIL COMING FROM CUSTOMERS and SUPPLIERS

Description: The current E-mail distribution process will be observed and process changes will be developed and recommended for implementation.

Rationale: Expedient and accurate communications between customers and suppliers is the principle value of using E-mail for ancillary communications.

Required Effort: Internal Staff: 2 days; <Consultant> Staff: 1 day

SUBTASK 2.2 DETERMINE BUSINESS USES OF E-MAIL

Description: With the involvement of the internal staff, all applications of E-mail between the company and their customers will be reviewed and defined from a business practice perspective.

Rationale: Determine the business uses and detailed configurations required for each individual customer (i.e., Ford, Chrysler, etc.) In addition, a result of E-mail implementation daily activities may need to be redefined. For example, if an individual in Customer Service (CS) historically

performed a rote process such as copying and distributing customer correspondence, they could now focus on evaluating the strategic quality of the responses. By redefining the business use of the process, an individual will have a clear and guided focus as their position changes.

Required Effort: Internal Staff: 5 days; <Consultant> Staff: 4 days

SUBTASK 2.3 DEVELOP E-MAIL GUIDELINES FOR USE BY TRADING PARTNERS

Description: Establish procedures and guidelines for using incoming and outgoing E-mail communications with individual trading partners.

Rationale: As a consortium <Company> and its trading partners will need to create a common set of protocols for communication. Policies might include; what type of information will be shared, who is authorized to share information, what is the expected response time to information, etc.

Required Effort: Internal Staff: 2 days; <Consultant> Staff: 2 days

SUBTASK 2.4 DEVELOP AND EXECUTE COMMUNICATIONS PLAN WITH TRADING PARTNERS

Description: The communication plan documents <Company>'s strategic intention for using the technology and the expected involvement of its trading partners.

Rationale: In order to exploit the benefits of E-mail communications both sides need to use a set communications plan which addresses the specific needs of each individual partner (outlined in Business Uses 2.2).

Required Effort: Internal Staff: 1 day; <Consultant> Staff: 1 day

SUBTASK 2.5 TRAIN USERS IN PINE/ PICO

Description: Train the users in the use of the new internal e-mail system.

Rationale: It is important that staff members be trained in the use of PINE/PICO e-mail system. Proper training increases the users' confidence in their ability to use the system. Training reduces user frustration by providing an introduction into the functions of the system and by instructing them in the proper sequence of the steps to successfully use e-mail.

Required Effort: Internal Staff: 2 days

SUBTASK 2.6 TRAIN USERS IN EXTERNAL E-MAIL USE

Description: Train the user community in the use of the external e-mail systems. Emphasis to be placed on the use of Novell GroupWise and the IBM Mail Exchange.

Rationale: This session will introduce the users to the different formats of external e-mail addresses, including SMTP Internet and X.400 styles. Train them on how to access the e-mail gateway and what to look for in case of problems.

Required Effort: Internal Staff: 2 days

SUBTASK 2.7 DEVELOP PROBLEM REPORTING AND TRACKING PROCEDURES FOR EXTERNAL E-MAIL

Description: Develop a formal problem reporting and tracking system to support the GroupWise environment.

Rationale: A formal problem reporting and tracking system to support the GroupWise environment will ensure that user problems are addressed promptly and the resolutions logged for future references.

Required Effort: Internal Staff: 3 days; <Consultant> Staff: 1 day

SUBTASK 2.8 DEVELOP FORMAL E-MAIL USE POLICY

Description: A written policy book will be prepared by <Company> and <Consultant> management containing the combined presentation of new processes, the Internal User's Guide, Guidelines for

Trading Partners, The Contingency Plan, and the overall Communications Plan. The E-mail Implementation Team will present the policy book to <Company> employees.

Rationale:

Required Effort: Internal Staff: 5 days; <Consultant> Staff: 1.5 days

TASK 3.0 TESTING

SUBTASK 3.1 ESTABLISH E-MAIL PERFORMANCE METRICS

Description: Appropriate metrics of performance for external e-mail will be determined. Methods will be established to measure actual performance.

Rationale: The establishment and use of performance metrics to measure the effectiveness of the e-mail environment. These metrics will include internal and external delivery and receiving timings, disk storage use, individual user volume statistics and other pertinent data. These metrics will also provide the capability to periodically exercise the system to insure all connections and capabilities are operational.

Required Effort: <ECRC/MEP> Staff: 2 days

SUBTASK 3.2 TEST INTERNAL E-MAIL

Description: Test the internal e-mail system and coordinate problem resolution with vendors.

Rationale: The formal testing of the internal e-mail environment will insure that all system software is properly installed, all e-mail features are fully functional and individual user accounts are correctly setup.

Required Effort: Internal Staff: 1 day; <ECRC/MEP> Staff: 1 day

SUBTASK 3.3 TEST EXTERNAL E-MAIL

Description: Test the external e-mail using <ECRC/MEP>. <ECRC/MEP> will coordinate resolution of problems with vendors.

Rationale: The formal testing of the external e-mail connectivity with the controlled environment of the <ECRC/MEP> Testbed will establish the soundness of its external communication before beginning the pilot implementation.

Required Effort: Internal Staff: .5 day; <ECRC/MEP> Staff: 2 days

SUBTASK 3.4 PILOT EXTERNAL E-MAIL

Description: Production use of e-mail will be piloted. Problems will be identified and resolved. Performance will be measured. Criteria for production-readiness will be established. This pilot implementation will test both the physical connection and e-mail business processes.

Rationale: Piloting the use of e-mail with a single trading partner will allow testing of the e-mail environment in a live but highly controlled situation. This will permit identification of technical bugs and/or business procedural difficulties and apply the corrections before deploying e-mail for wide spread use.

Required Effort: Internal Staff: 2 days; <ECRC/MEP> Staff: 1 day; <Consultant> Staff: .5 day

SUBTASK 3.5 PRODUCTION ROLLOUT

Description: Production use of e-mail will be phased in trading partners. Task includes development of formal procedures to add and delete trading partners.

Rationale: The phased approach to the production rollout of e-mail and its associated business procedures will allow identification of any trading partner specific communications or process problems in a controlled manner. This approach will permit the timely application of corrective actions in each case. The development of a method to add and delete trading partners will provide the means to continuously tune and improve the e-mail environment.

Required Effort: Internal Staff: 1 day per trading partner

TASK 4.0 SUPPORT

SUBTASK 4.1 DEVELOP PROCESS FOR E-MAIL IMPROVEMENTS

Description: A system will be established to identify and implement improvements to the e-mail system.

Rationale: All mechanical and electronic devices are subject to failure. Failures may spring from many causes and have various affects on the e-mail and business systems. This plan will establish the procedures for restoring the systems to operating condition after the cause of the failure has been identified and removed. This plan can be worked into the current system backup procedures.

Required Effort: Internal Staff: 2 days; <Consultant> Staff: 1.5 days

SUBTASK 4.2 DEVELOP AND TEST DISASTER/CONTINGENCY PLAN

Description: Procedures will be developed to maintain critical business processes when failures occur in the internal and/or external e-mail system.

Rationale: All mechanical and electronic devices are subject to failure. Failures may spring from many causes and have various affects on the e-mail and business systems. This plan will establish the procedures for restoring the systems to operating condition after the cause of the failure has been identified and removed. This plan can be worked into the current system backup procedures.

Required Effort: Internal Staff: 2 days; <Consultant> Staff: 1.5 days

SUBTASK 4.3 DEVELOP ON-GOING PERFORMANCE TESTING

Description: A system will be developed to pro-actively exercise and test system functions to identify problems and measure performance.

Rationale: Periodic testing of the internal and external e-mail system and network connectivity will aid in identifying problems. Performing this testing on a regular basis will minimize the potential for discovering a failure at a critical time; e.g., when an important e-mail message or E-MAIL transaction set is sent by a trading partner concerning an order or shipment;

Required Effort: Internal Staff: 1 day; <ECRC/MEP> Staff: 2 days

SUBTASK 4.4 UPDATE MAINTENANCE PROCEDURES

Description: Update backup procedures, trouble reporting and tracking methods, hardware and software configuration tracking processes to include e-mail environment.

Rationale: The establishment of a robust and stable e-mail system requires the development of maintenance procedures. Backup procedures for the internal e-mail environment is critical in order to maintain restorable records of business transaction, preserve addressing configurations, systems settings, etc. Trouble reporting and tracking methods are necessary to insure not only that reported problems are corrected but also to establish records of reoccurring problems to assist in the isolation of the root cause of the problem. Even seemingly minor problems that occur repeatedly are signs that something more profound is wrong with a computer system. Hardware and software configuration information must be established and updated so that this important data is readily available when needed for problem solving.

Required Effort: Internal Staff: 3 days

SUBTASK 4.5 TEST BACKUP METHODS

Description: The e-mail system will be restored from backups and shown to be operational.

Rationale: This task will test the backup and recovery procedures to insure that they will be successful if and when they are needed.

Required Effort: Internal Staff: 1 day

TASK 5.0 PROJECT MANAGEMENT

SUBTASK 5.1 ESTABLISH IMPLEMENTATION TEAM

Description: The e-mail implementation team will be established. The roles of team members will be identified. The clear business objective of the project will be established.

Rationale: The persons who will need to perform tasks for this implementation are identified and their roles established. This is required to ensure the right people are assigned to the tasks and that any one person is not overextended during the course of the project.

Required Effort: Internal Staff: .25 day; <ECRC/MEP> Staff: .25 day; <Consultant> Staff: .25 day

SUBTASK 5.2 ESTABLISH PROJECT RESOURCES

Description: Budgets, authority, and staff time commitments will be made.

Rationale: The persons who will need to perform tasks for this implementation are identified and their roles established. Additional resources need to identified and committed to the project. Financial requirements and commitments must also be established to ensure resources will be available to complete the project.

Required Effort: Internal Staff: .5 day; <ECRC/MEP> Staff: .5 day; <Consultant> Staff: .5 day

SUBTASK 5.3 DEVELOP BUSINESS METRICS

Description: Metrics will be established to determine the degree to which the business objectives for e-mail are being met.

Rationale: E-mail has the potential for improving the speed and accuracy of information exchanged between trading partners. Comparison needs to be made between the current paper processes and the new e-mail processes. Measuring items such as communication time, expedited shipments, and others affected by the speed and quality of information will help determine the actual benefits realized from the implementation.

Required Effort: Internal Staff: 1 day; <ECRC/MEP> Staff: .5 day; <Consultant> Staff: 2 days

SUBTASK 5.4 ESTABLISH SCHEDULE

Description: A project schedule will be developed. A list of open action items will be maintained.

Rationale: Provides for a list of tasks with projected start and end dates with assigned resources. This schedule establishes the framework for the project's progress and accomplishments.

Required Effort: Internal Staff: 1 day; <ECRC/MEP> Staff: .5 day; <Consultant> Staff: .5 day

SUBTASK 5.5 TRACK PROJECT PROGRESS

Description: Track the project's progress and completion of tasks.

Rationale: Tracking progress ensures the completion of project tasks and help identify any conditions which may cause delays or require changes in the project schedule.

Required Effort: Internal Staff: .5 days; <ECRC/MEP> Staff: 2 days; <Consultant> Staff: 2 days

Detail Costs:

[This section is comprised of two table listing detail costs for Initial Implementation and On-going activities.]

EXAMPLE:

Purchased Software, Hardware, and Services

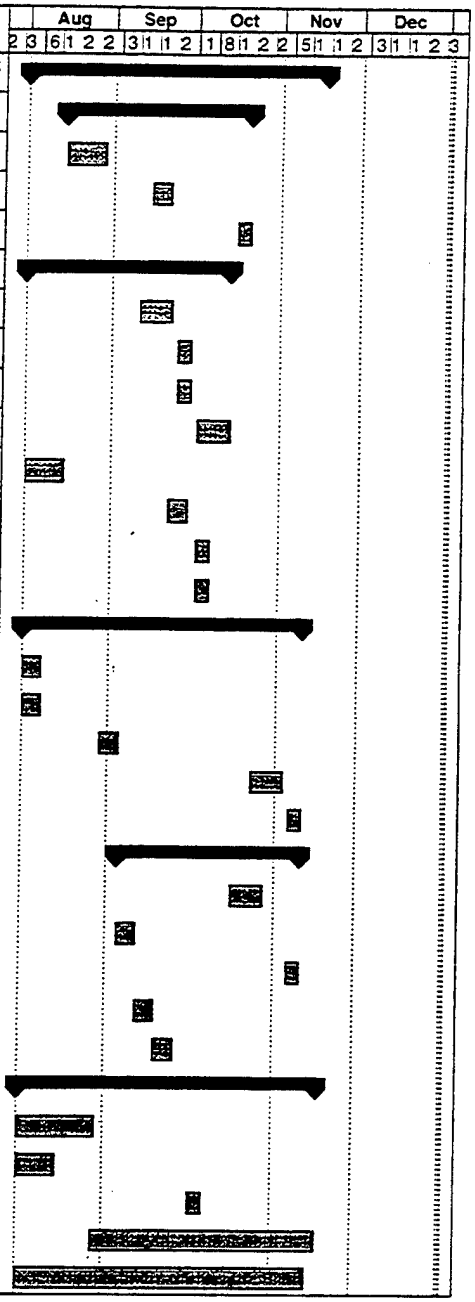
Initial Cost	Number	Unit Cost	Extended Cost
Internet Connection	1	$750.00	$750.00
TOTAL			**$750.00**

On-going Cost	Cost / Month
Internet Mail	$75.00
TOTAL	**$75.00**

Work Level and Schedule

[This section is a gannt chart of the detail task showing beginning and completion dates for each major task and its component subtasks. Columns are included for the time required for each participating organization in the project.

ID	Task Name	Task#	CO.	MEP	CON
8	Implement E-mail	2	44.25	8.75	18.25
9	**Acquire HW SW Services**	2.1	6	0	0
10	Select Internet Service Provider	2.1.2	3	0	0
11	Install internet Connection	2.1.3	2	0	0
12	Install PINE/PICO E-mail Application	2.1.4	1	0	0
13	**Modify Business Processes**	2.2	19	0	10.5
14	Develop Cutomer/Supplier E-mail Proce	2.2.1	2	0	1
15	Determine Business Uses of E-mail	2.2.2	5	0	4
16	Develop E-mail Guidelines for Use By T	2.2.3	2	0	2
17	Develop and Execute Communnication	2.2.4	1	0	1
18	Train Users in PINE/PICO	2.2.5	2	0	0
19	Train Users in External E-mail Use	2.2.6	2	0	0
20	Develop problem Reporting & Tracking	2.2.7	3	0	1
21	Develop Formal E-mail Use Policy	2.2.8	3	0	1.5
22	**Testing**	2.3	4.5	4	0.5
23	Establish E-mail Performance Metricis	2.3.1	0	2	0
24	Test Internal E-mail	2.3.2	1	0.5	0
25	Test External E-mail	2.3.3	0.5	0.5	0
26	Pilot External E-mail	2.3.4	2	1	0.5
27	Production Rollout	2.3.5	1	0	0
28	**On-Going Support**	2.4	10	2	3
29	Develop Process for E-mail Improveme	2.4.1	2	0	1.5
30	Develop and Test Disaster/Contigncy I	2.4.2	2	0	1.5
31	Develop On-Going performance Testing	2.4.3	2	2	0
32	Update Maintenance Procedures	2.4.4	3	0	0
33	Test Backup Methods	2.4.5	1	0	0
34	**Project Management**	2.5	4.75	2.75	4.25
35	Establish Implementation Team	2.5.1	0.25	0.25	0.25
36	Establish Project Resources	2.5.2	0.5	0.5	0.5
37	Establish Business Metrics	2.5.3	1	0.5	2
38	Establish Schedule	2.5.4	1	0.5	0.5
39	Track Project Progress	2.5.5	2	1	1



8.2 Appendix B: 2-Way EDI Plan Template

<Company Name> 2-Way EDI Implementation Plan

EDI Team:

<Company Representative> (Project Manager)

<Field Agent>, <ECRC/MEP> (Filed Agent Role)

<Consultant>, <Consultant> Systems (Services Provided)

<Vendor Technical Rep>, <Vendor> (Product Description)

Objective:

[This section contains a brief statement of the overall objective of the plan.]

EXAMPLE:

Implement EDI with Company B and other trading partners. By using EDI for business information exchange, information will be sent and received more quickly. This will enable development of methods for mechanically exchanging data between the EDI and business applications to implement the integration recommendation of the project.

Current Situation:

[This section describes the current level of the current computer environment(both hardware and application systems) and EDI activity within the company. It should include a statement of the requests that the firms had for EDI trading.]

EXAMPLE:

There are no EDI connections in place. <Trading Partner> has requested EDI connectivity beginning with the Material Release (830) transaction and will add the Ship Notice (856) near the end of the year. Other customers have inquired about EDI communications but have not published any requirements.

Internal business applications are part of the <Manufacturing Software Package Name> provided by <Vendor Name> of <City, State>. This is an integrated package which runs in the DOS environment and provides modules for order entry, accounting, shop scheduling, and shipping. This package will be capable of file import/export with EDI translation packages in the third quarter for the integration recommendation.

The computers are connected to a LANtastic Local Area Network with one server and five client workstations. All workstations are Gateway 2000 personal computers with desktop applications operating under Windows 3.1, except for the <Manufacturing Software Package>. A Windows version of the <Manufacturing Software Package> is scheduled for the fourth quarter of 1995.

Plan:

[This section gives a description of the planned EDI implementation with a bullet list of major activities and a gannt chart of the high level tasks from the Detail Task Description Section.]

EXAMPLE:

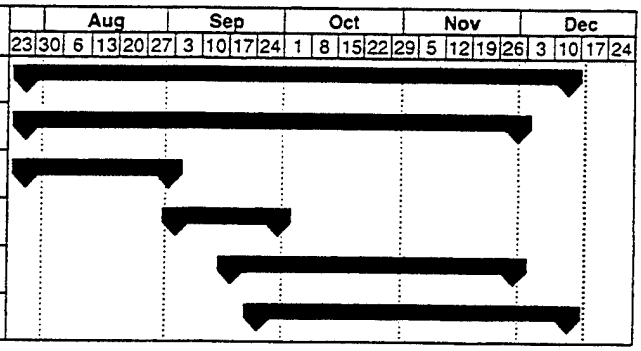
<Vendor> software will be used to establish EDI communications with <Trading Partner> as a pilot for the <EDI PROJECT> project. When <Company B> is ready to establish EDI communications with suppliers, the appropriate overlays for the EDI software will be added, trading partnerships set up, and <Company B> EDI data tested. The components of the plan include:

- Obtain and install EDI translation software
- Obtain Value Added Network services

- Modify business processes for electronic receipt and transmission of information
- Test and pilot EDI data exchange
- Production EDI with customers

This plan has the following major tasks and timeline:

ID	Task Name	Task :	Co.	MEP	Con
43	Implement EDI	1	73.75	8	13.5
44	Project Management	1.1	7.25	3	5.25
50	Acquire Software & Services	1.2	4.5	0.5	0
56	Modify Business Processes	1.3	8	0.5	3.5
60	Test EDI Connections	1.4	25.5	3	0
69	Support	1.5	28	1	4.5



Benefits/Cost Analysis:

[This section contains a text statement of the Benefit/Cost Analysis and a table showing the dollar amounts to be spent plus the required staff times of the participating companies to complete the project.]

EXAMPLE:

The immediate benefit is the reduction in time lost in transit of business documents. Having information available more quickly will allow better production planning, scheduling, and material purchasing. This may also contribute to shorter lead times, fewer expedited orders, faster response to customer requirement changes, and lower inventory levels.

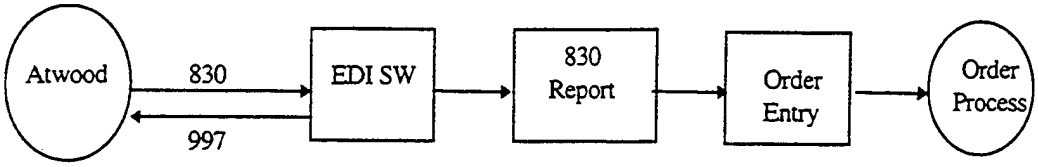
In the future, more customers and potential customers will use EDI capability as a criterion for placing business. A proven ability to send and receive EDI transactions will provide a competitive advantage over other companies without EDI capability. When EDI transactions are eventually integrated into the business applications system, significant time and cost savings will be realized by reducing the manual transcription of customer data.

The costs to implement this plan include:

EDI Costs	**Initial**	**On-going**
Purchased Software and Services	$3000-$4000	$120–$180/month
<COMPANY NAME> Staff	73.75 days	1 day/week
<ECRC/MEP> Staff	8.00 days	N/A
<Consultant> Staff	13.5 days	N/A

Block Diagram: [This is a simple graphical representation of the EDI Transaction flow described in the plan.]

EXAMPLE:



Configuration:

[This section provides a brief text statement of the planned 2-way EDI implementation.]

EXAMPLE:

The EDI translator will be installed on a workstation on the LANtastic network. Received transactions (e.g., 830) will be printed out and re-keyed into the order processing module. Functional Acknowledgments (997) are automatically generated by the <Vendor> translator for incoming documents and responses to outgoing documents are matched and flagged as received by <EDI TRANSLATION PACKAGE>.

Detail Task Descriptions:

[This section provides a listing of all the detail tasks required to complete the 2-Way EDI Plan. Each subtask contains a Description of the task plus a Rationale or justification for the activity and the Required Effort for those parties executing the particular subtask. The example below contains the most common tasks for such an effort. Additional tasks may be required for any specific implementation of 2-Way EDI.]

TASK 1.0 PROJECT MANAGEMENT

SUBTASK 1.1 ESTABLISH IMPLEMENTATION TEAM

Description: Determine the individuals who will be involved in the EDI implementation phase.

Rationale: The persons who will need to perform tasks for this implementation are identified and their roles established. This is required to ensure the right people are assigned to the tasks and that any one person is not overextended during the course of the project.

Required Effort: Internal Staff: .25 day; <Consultant> Staff: .25 day; <ECRC/MEP> Staff: .25 day

SUBTASK 1.2 DETERMINE PROJECT RESOURCES

Description: Establish required budgets, Staff, hardware, software, and other resources.

Rationale: The persons who will need to perform tasks for this implementation are identified and their roles established. Additional resources need to identified and committed to the project. Financial requirements and commitments must also be established to ensure resources will be available to complete the project.

Required Effort: Internal Staff: .5 day; <Consultant> Staff: .5 day; <ECRC/MEP> Staff: .5 day

SUBTASK 1.3 DEVELOP BUSINESS METRICS

Description: Establish how to measure progress toward the meeting of the business objectives of EDI communication.

Rationale: EDI has the potential for improving the speed and accuracy of information exchanged between trading partners. Comparison needs to be made between the current paper processes and the new EDI processes. Measuring items such as communication time, expedited shipments, and others which are affected by the speed and quality of information will help determine the actual benefits realized from the implementation.

Required Effort: Internal Staff: 1 day; <Consultant> Staff: 2 days

SUBTASK 1.4 DEVELOP PROJECT SCHEDULE

Description: Develop an implementation schedule with task duration and milestones.

Rationale: Provides for a list of tasks with projected start and end dates with assigned resources. This schedule establishes the framework for the project's progress and accomplishments.

Required Effort: Internal Staff: 1 day; <Consultant> Staff: .5 day; <ECRC/MEP> Staff: .25 day

SUBTASK 1.5 TRACK PROJECT PROGRESS

Description: Track the project's progress and completion of tasks.

Rationale: Tracking progress ensures the completion of project tasks and helps identify any conditions which may cause delays or require changes in the project schedule.

Required Effort: Internal Staff: 5 days; <Consultant> Staff: 2 days; <ECRC/MEP> Staff 2 days

TASK 2.0 ACQUIRE SOFTWARE AND SERVICES

SUBTASK 2.1 ORDER EDI SOFTWARE

Description: Order <EDI TRANSLATION PACKAGE> EDI translation software from <Vendor>

Rationale: An EDI translator package is needed to send and receive EDI transactions. The software needs to handle multiple trading partners with differing implementation conventions. The package must also have file import and export capabilities to interface with the <Manufacturing Software Package> for future integration. The <EDI TRANSLATION PACKAGE> package handles all these requirements.

Required Effort: Internal Staff: 1 day

SUBTASK 2.2 INSTALL EDI SOFTWARE

Description: Load the EDI translator software on the PC workstation.

Rationale: The software must be installed and configured on the workstation that will be used to handle EDI processing.

Required Effort: Internal Staff: .5 day

SUBTASK 2.3 ORDER VAN SUBSCRIPTION

Description: Obtain a subscription (user ID and mailbox) to the <Selected Carrier> Value Added Network (VAN).

Rationale: The recommended network is the <Selected Carrier> VAN since both <Company B> and <Trading Partner> use this network. <Vendor> is a business partner with <Selected Carrier> and could be used to help with the initial communications start-up.

Required Effort: Internal Staff: 1 day

SUBTASK 2.4 EDI SOFTWARE TRAINING

Description: Training for the use of the <EDI TRANSLATION PACKAGE> software package.

Rationale: As with any new software package, the operators need training on the features and operations of the program. This training includes installation, configuration, communication, adding and removing trading partners, updating with new overlays and log-ons, sending and receiving transactions, and other day-to-day operations. Rick Richter to receive initial training and will train other operators as required.

Required Effort: Internal Staff: 1 day

SUBTASK 2.5 ESTABLISH TRADING PARTNER AGREEMENT WITH <COMPANY B> AND IMPLEMENT ON THE <SELECTED CARRIER> VAN

Description: Add <Company B> as a trading partner on the <Selected Carrier> Value Added Network (VAN).

Rationale: In order to send and receive transactions with trading partners via the <Selected Carrier> VAN, a trading partner profile has to be completed and verified by both parties. The

profile identifies transactions, versions, addresses, and distribution of charges. This information must first be established as a Trading Partner Agreement between <Company Name> and <Company B>.

Required Effort: Internal Staff: 1 day; <ECRC/MEP> Staff .5 day

TASK 3.0 MODIFY BUSINESS PROCESSES

SUBTASK 3.1 DEVELOP EDI SENDING AND RECEIVING PROCEDURES

Description: Establish procedures for the use of incoming and outgoing EDI transactions in place of paper documents. These new procedures involve changes in the way documents and other information are interpreted and distributed.

Rationale: The print-outs of incoming EDI releases will look different than the paper forms currently in use by customers so staff must be trained in the interpretation of the data to provide the same input to the order processing module. Outbound shipments are already keyed into the shipping module of <Manufacturing Software Package> and must also be keyed into the <EDI TRANSLATION PACKAGE> 856 overlay for transmission to the customer. These documented procedures are also needed for the operators of the EDI system to correctly operate the software and communications to reduce the training time for new operators.

Required Effort: Internal Staff: 3 days; <Consultant> Staff: .5 day; <ECRC/MEP> Staff .5 day

SUBTASK 3.2 DEVELOP EDI DATA ARCHIVING PROCEDURES

Description: Establish procedures for the archiving of EDI data.

Rationale: EDI transactions need to be archived off the workstation to have them available in case any transactions need to be re-processed. This should be worked into the standard system back-up procedures. Policies and procedures also need to be developed for the removal of the EDI transactions after they no longer have business value.

Required Effort: Internal Staff: 2 days; <Consultant> Staff: 2 days

SUBTASK 3.3 TRAIN PERSONNEL ON NEW PROCEDURES

Description: Training for the updated EDI procedures and processes.

Rationale: Personnel need to be trained in the procedures of each new business process introduced. This training includes sending, receiving, interpreting output, and processing input and output. The EDI system operator will need to perform communication and translation sessions to send and receive the additional transactions. The print-outs of incoming EDI releases will look different than the paper forms currently used by <Trading Partner> and <Company B>, so staff must be trained in the interpretation of the data to provide the same input to the order processing module. Additional training is needed on inputting Shipping Notices in the <EDI TRANSLATION PACKAGE> software.

Required Effort: Internal Staff: 3 days; <Consultant>: 1 day

TASK 4.0 TEST EDI CONNECTIONS

SUBTASK 4.1 TEST VAN COMMUNICATIONS

Description: Perform communications tests with the <Selected Carrier> VAN provider.

Rationale: This testing shows that log-ons, protocols, etc., are properly configured and that <COMPANY NAME> is able to both send and receive transactions with the VAN.

Required Effort: Internal Staff: 1 day

SUBTASK 4.2 TEST <EDI TRANSLATION PACKAGE> OPERATION

Description: Test the <EDI TRANSLATION PACKAGE> translator software to ensure it operates as advertised.

Rationale: While software companies design their products to operate with a variety of system configurations, each company has a unique hardware and software environment. This task is to determine if the <EDI TRANSLATION PACKAGE> package operates in this computing environment, that parameters are properly set, and that the translator is properly working with the communications module.

Required Effort: Internal Staff: 2 days

SUBTASK 4.3 TEST EDI TRANSACTION EXCHANGE WITH <ECRC/MEP> TESTBED

Description: Exchange EDI transactions with the <ECRC/MEP> EDI Testbed to prove ability to send and receive with a trading partner.

Rationale: Testing with the <ECRC/MEP> Testbed under controlled conditions will prove out the system for correct installation and configuration before starting to pilot with trading partners. Any problems with the basic functionality of the EDI exchanges will be discovered and resolved at this point.

Required Effort: Internal Staff: 3 days; <ECRC/MEP> Staff: 1 day

SUBTASK 4.4 PILOT EDI WITH <TRADING PARTNER>

Description: Send and receive Mercury EDI transactions using production data and comparing to current documents to assure correct information.

Rationale: This task is used to prove the system by comparing actual production data received via EDI with the same data sent by paper forms. When <COMPANY NAME> and Mercury are confident that all transactions are properly processed, the system can be put into production.

Required Effort: Internal Staff: 5 days

SUBTASK 4.5 PRODUCTION TURNOVER WITH <TRADING PARTNER>

Description: Use the EDI transactions for communication with Mercury and stop the use of paper-based releases and packing slips.

Rationale: Once the system has been proven to provide the correct information required in a timely manner, electronic communications can be used exclusively and paper documents no longer need to be exchanged.

Required Effort: Internal Staff: .5 day

SUBTASK 4.6 CONFIGURE EDI SYSTEM FOR <COMPANY B>

Description: Add overlays, set up trading partnerships, addressing, and communications parameters for <Company B>.

Rationale: The differences in implementation between <Company B> and Mercury require a different set of transactions, overlays, network addresses and trading partner specifications. The <EDI TRANSLATION PACKAGE> software must be configured to recognize <Company B>'s transaction sets, properly translate them, and exchange appropriate acknowledgments.

Required Effort: Internal Staff: 1 day; <ECRC/MEP> Staff: .5 day

SUBTASK 4.7 PILOT EDI WITH <COMPANY B>

Description: Send and receive <Company B> EDI transactions using production data and compare to current documents to assure correct information.

Rationale: This task is used to prove the system by comparing actual production data received via EDI with the same data sent by paper forms. When all parties are confident that all transactions are properly processed, the system can be put into production.

Required Effort: Internal Staff: 10 days; <ECRC/MEP> Staff: 1 day

SUBTASK 4.8 PRODUCTION TURNOVER WITH <COMPANY B>

Description: Use EDI transactions for communication with <Company B> and stop the use of paper-based releases and packing slips.

Rationale: Once the system has been proven to provide the correct information required in a timely manner, electronic communications can be used exclusively and paper documents no longer need to be exchanged.

Required Effort: Internal Staff: 1 day

TASK 5.0 SUPPORT

SUBTASK 5.1 DEVELOP PROCESS FOR IMPROVING EDI USE

Description: Determine methods to identify and implement improvements in the EDI system.

Rationale: As more EDI transactions are exchanged, procedures which could use improvement will be identified. These processes need to be analyzed to determine what changes are required and how to put them into effect.

Required Effort: Internal Staff: 2 days; <Consultant> Staff: 1 day; <ECRC/MEP> Staff: .5 day

SUBTASK 5.2 DEVELOP AND TEST DISASTER AND RECOVERY PLAN

Description: Develop a plan to recover from equipment or software failures.

Rationale: All mechanical and electronic devices are subject to failure. Failures may spring from many causes and have various affects on the EDI and business systems. This plan will establish the procedures for restoring the system to operating condition after the cause of the failure has been identified and removed. This plan can be worked into the current system backup procedures.

Required Effort: Internal Staff: 5 days; <Consultant> Staff: 1 day

SUBTASK 5.3 DEVELOP CONTINUOUS PERFORMANCE TESTING PROCEDURES

Description: Develop procedures for testing and monitoring the system's performance in day-to-day operations

Rationale: With the additional demands EDI exchange puts on the system, the system's performance needs to be monitored to identify any possible problems to which the EDI processing may contribute. This continuous monitoring will help avoid disruptions in service for both the EDI and business applications.

Required Effort: Internal Staff: 5 days; <Consultant> Staff: 2 days

SUBTASK 5.4 DEVELOP MAINTENANCE PROCEDURES

Description: Develop procedures to keep the system hardware and software up to date and properly functioning.

Rationale: Computer software and hardware require occasional maintenance. Software packages have periodic enhancements and upgrades. Hardware, especially mechanical items such as disk and tape drives require some routine maintenance to keep them operating properly. These procedures will help avoid system down time and keep the system operating at its most efficient level.

Required Effort: Internal Staff: 5 days; <Consultant> Staff: .5 day

SUBTASK 5.5 DEVELOP SYSTEM BACKUP PLAN

Description: Develop a plan for the regular backup and safe archiving of critical applications and files.

Rationale: The best insurance against data loss is the methodical backup of applications and data. These backups can be used to restore the system as part of the disaster recovery plan in SUBTASK 5.2. These backup and recovery procedures need to be regularly tested to ensure their effectiveness. These plans will be enhancements to the current system backup procedures.

Required Effort: Internal Staff: 1 day; <ECRC/MEP> Staff .5 day

SUBTASK 5.6 COMPARE PAPER AND ELECTRONIC TRANSACTIONS

Description: Compare the paper and electronic transactions for consistency and accuracy of information.

Rationale: Additional Staff will be required to compare the report and file data for inbound and outbound transactions in preparation for the integration phase. This comparison will establish that same information is sent and received by electronic exchange as was moved by paper. Once the quality of data is assured, the integration phase can proceed to mechanize the business application processing of the EDI information.

Required Effort: Internal Staff: 10 days

Detail Cost:

[This section is comprised of two table listing detail costs for Initial Implementation and On-going activities.]

EXAMPLE:

Purchased software and services:

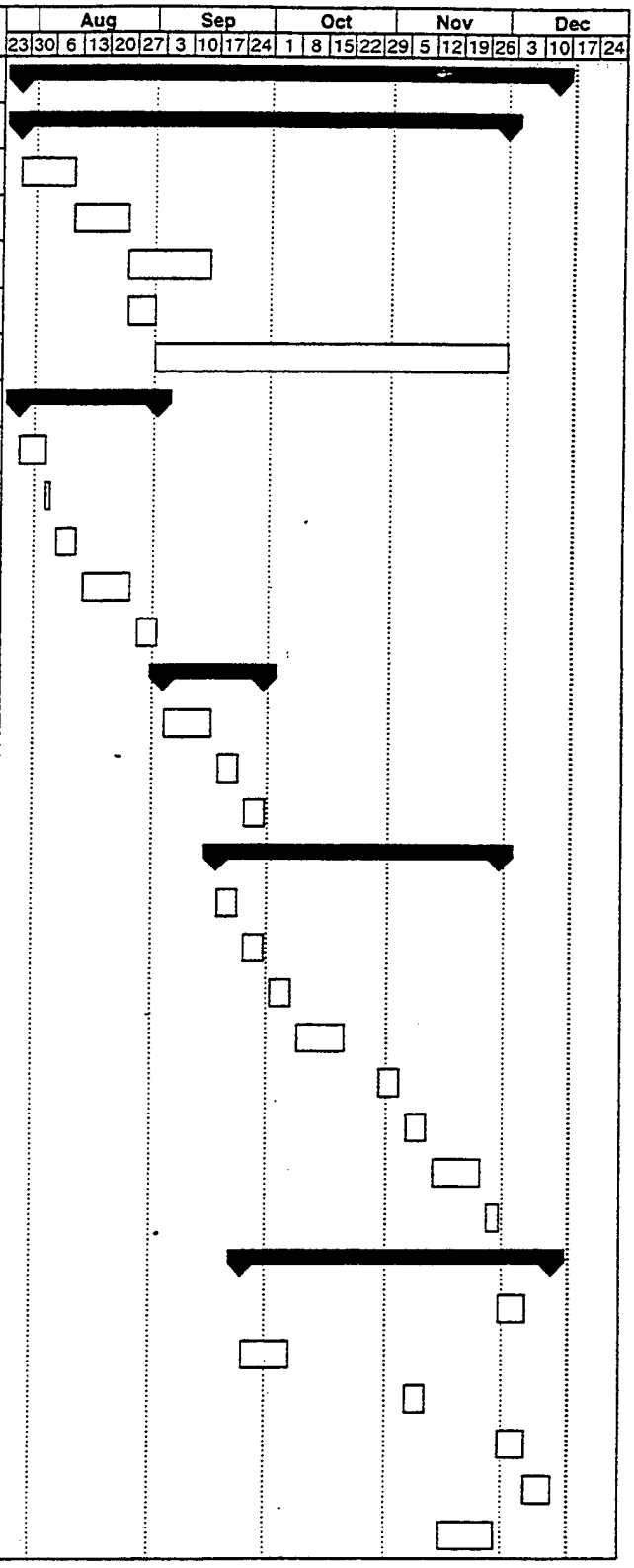
Initial Cost	Unit Cost
<EDI TRANSLATION PACKAGE> translation software	$1500
Additional overlays for <Company B>	$900–1500
First year maintenance fee for <EDI TRANSLATION PACKAGE>	$660

On-going Costs	Unit Cost/basis
<EDI TRANSLATION PACKAGE> annual maintenance	$660/year
<Selected Carrier> mailbox maintenance fee	$53/month
<Selected Carrier> usage fees	est. $0.22/1000 characters

Work Level and Schedule

[This section is a gannt chart of the detail task showing beginning and completion dates for each major task and its component subtasks. Columns are included for the time required for each participating organization in the project.]

ID	Task Name	Task	Co.	MEP	Con
43	**Implement EDI**	1	73.75	8	13.5
44	**Project Management**	1.1	7.25	3	5.25
45	Establish implementation te	1.1.1	0.25	0.25	0.25
46	Determine project resource	1.1.2	0.5	0.5	0.5
47	Develop business metrics	1.1.3	1	0	2
48	Develop project schedule	1.1.4	1	0.25	0.5
49	Track project progress	1.1.5	5	2	2
50	**Acquire Software & Services**	1.2	4.5	0.5	0
51	Order EDI software	1.2.1	1	0	0
52	Install EDI software	1.2.2	0.5	0	0
53	Order VAN subscription	1.2.3	1	0	0
54	EDI software training	1.2.4	1	0	0
55	Establish trading partnershi	1.2.5	1	0.5	0
56	**Modify Business Processes**	1.3	8	0.5	3.5
57	Develop EDI sending & rec	1.3.1	3	0.5	0.5
58	Develop EDI data archiving	1.3.2	2	0	2
59	Train personnel on new prc	1.3.3	3	0	1
60	**Test EDI Connections**	1.4	25.5	3	0
61	Test VAN communications	1.4.1	1	0	0
62	Test STX operation	1.4.2	2	0	0
63	Test with ITI testbed	1.4.3	5	1	0
64	Pilot with Mercury Marine	1.4.4	5	0	0
65	Production with Mercury M:	1.4.5	0.5	0	0
66	Configure for Atwood	1.4.6	1	0.5	0
67	Pilot with Atwood	1.4.7	10	1	0
68	Production with Atwood	1.4.8	1	0	0
69	**Support**	1.5	28	1	4.5
70	Develop EDI improvement	1.5.1	2	0.5	1
71	Develop & test disaster plar	1.5.2	5	0	1
72	Develop continuous perfor	1.5.3	5	0	2
73	Develop maintenance proc	1.5.4	5	0	0.5
74	Develop backup plan	1.5.5	1	0.5	0
75	Compare Paper and electrc	1.5.6	10	0	0



8.3 Appendix C: Integrated EDI Plan Template

<Company> Integration Implementation Plan

Integration Team:

<Company Representative> (Project Manager)

<Field Agent>, <ECRC/MEP> (Filed Agent Role)

<Consultant>, <Consultant> Systems (Services Provided)

<Vendor Technical Rep>, <Vendor> (Product Description)

Objective:

[This section contains a brief statement of the overall objective of the plan.]

EXAMPLE:

To mechanize the transfer of data from the <EDI SOFTWARE> and the job shop control system. Mechanizing the system will eliminate hand-keying of data into both the EDI and business application systems. Eliminating hand-keying will speed up the movement of information between the systems and eradicate transcription errors.

Current Situation:

[This section describes the current level of the current computer environment(both hardware and application systems) and EDI activity within the company. It should include a statement of the requests that the firms had for EDI trading.]

EXAMPLE:

Currently exchanging EDI documents with Ford, General Seating of America, and <Company B> Automotive. Incoming EDI transactions are printed to paper and keyed into the shop control system. Outgoing transactions are keyed into the EDI translator from paper reports output from the business application system.

The business applications are part of an integrated shop control and management system on a UNIX application and file server. The shop management system consists of order entry, job scheduling, accounting, and shipping modules. The modules are integrated and share information between the business functions. The system is also capable of file import and export with an EDI application to help implement the integration recommendation of this project.

The UNIX server and Personal Computer workstations are connected through fast Ethernet cabling. The Netware server has a gateway to the UNIX server to enable movement of data between the systems.

Plan:

[This section gives a description of the planned EDI integration implementation with a bullet list of major activities and a gannt chart of the high level tasks from the Detail Task Description Section.]

EXAMPLE:

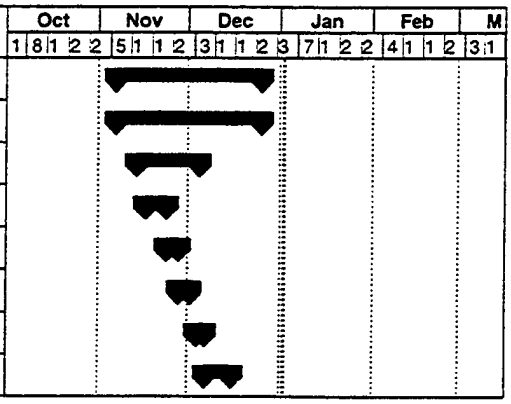
Establish file transfer and mechanical data exchange capabilities between the shop management system and the EDI package. A procedure for moving the data from the PC to the UNIX server needs to be developed to permit the business applications to use EDI data without manual input. Develop file reformatting programs for converting EDI to application data for mechanical updating of business systems. Review the information interchange capabilities of the shop management modules to ensure the complete sharing of information between the processes. Integration will be based on the data analysis and comparison performed as part of the EDI implementation previously completed. The components of the plan include:

- Develop file translation software from EDI to business applications

- Develop interfaces between PC and UNIX systems to move data between EDI and business applications
- Test integrated systems
- Production use of integrated EDI and business applications

This plan has the following major tasks and timeline:

ID	Task Name	Task#	CO:	MEP	CON
75	EDI Integration	8	44	6.25	10
76	Project Management	8.1	7.75	3	5
82	Modify Business Processes	8.2	12	1	3
86	Map EDI to Application Formats	8.3	1.25	0.75	0
89	Develop Software	8.4	5	0	0
91	Test EDI to Application Interfaces	8.5	7	1.5	0
94	Production Turnover of Integrated Systen	8.6	5	0	0
97	Support	8.7	6	0	2



Benefits/Cost Analysis:

[This section contains a text statement of the Benefit/Cost Analysis and a table showing the dollar amounts to be spent plus the required staff times of the participating companies to complete the project.]

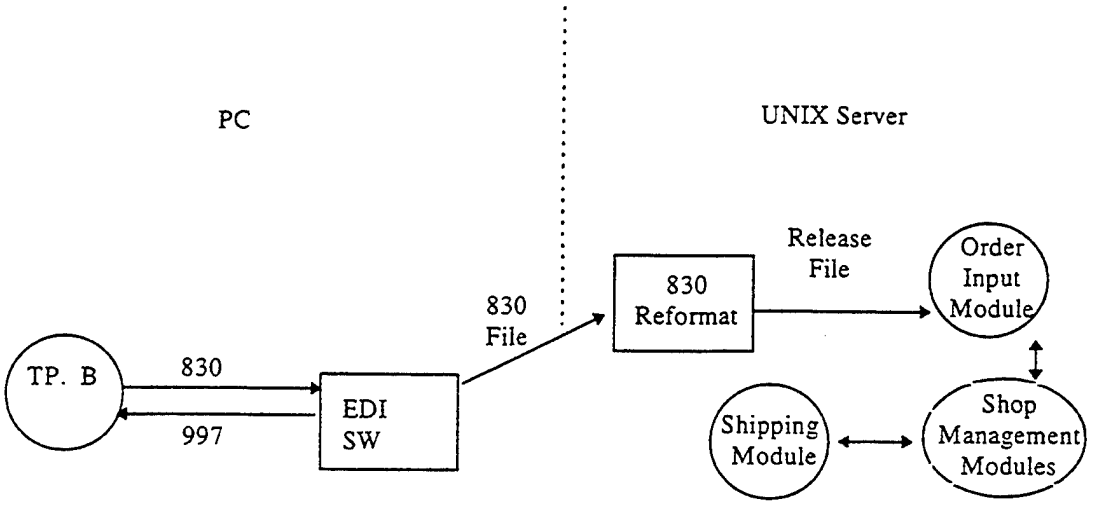
EXAMPLE:

Integration of EDI and business applications should result in significant savings by eliminating the re-keying of information between the EDI and business applications. The savings would come from both time not used to re-enter data between the systems and reduction in transcription errors by the manual manipulation of business information.

Integration Costs	Initial	On-going
Internal Staff	44.00 days	1 day/week
<MEP> Staff	6.25 days	N/A
<Consultant> Staff	10.00 days	N/A

Block Diagram: *[This is a simple graphical representation of the EDI Transaction integration flow described in the plan.]*

EXAMPLE:



Configuration:

[This section provides a brief text statement of the planned EDI integration implementation.]

EXAMPLE:

The configuration will have the PC communicating with <Company B> through the General Electric Information Services (GEIS) Value Added Network (VAN) to retrieve Releases and deliver Shipping Notices. The PC running <EDI SOFTWARE> will translate between EDI transactions and a flat file which will contain segment information and business data. The PC will output an 830 Release format file for transfer to the UNIX server to be reformatted into an application release file for input to the order entry module. The Functional Acknowledgments (997) are processed internally by the EDI package and do not need any external interfaces.

The Shipping Schedule (862) is the only second-priority transaction that would be cost-effective to integrate. This is dependent on <Company B>'s decision whether the 862 will be used for delivery of material, since no other customers have this requirement. The Shipping Schedule data would be translated and reformatted to a file which would be input to the order entry application to update shipping requirements.

The EDI translator files will be moved between the PC and UNIX server using the Novell networking system. The UNIX server will have the applications which map the data between the translator file formats and the business application formats. Interface programs will start the processes of updating the business applications and generating output files for the EDI translator. The shop management applications will handle the sharing/movement of data between the modules.

Detail Task Descriptions:

[This section provides a listing of all the detail tasks required to complete the EDI Integration Plan. Each subtask contains a Description of the task plus a Rationale or justification for the activity and the Required Effort for those parties executing the particular subtask. The example below contains the most common tasks for such an effort for an 830 transaction set. Additional tasks may be required for any specific implementation of EDI integration or more transaction sets.]

TASK 1.0 PROJECT MANAGEMENT

SUBTASK 1.1 ESTABLISH IMPLEMENTATION TEAM

Description: Determine the individuals who will be involved in the integration phase.

Rationale: The persons who will need to perform tasks for this implementation are identified and their roles established. This is required to ensure the right people are assigned to the tasks and that any one person is not overextended during the course of the project.

Required Effort: Internal Staff: .25 day; <Consultant> Staff: ; <MEP> Staff: .25 day

SUBTASK 1.2 DETERMINE PROJECT RESOURCES

Description: Establish required budgets, Staff, hardware, software, and other resources.

Rationale: The persons who will need to perform tasks for this implementation are identified and their roles established. Additional resources need to identified and committed to the project. Financial requirements and commitments must also be established to ensure resources will be available to complete the project.

Required Effort: Internal Staff: .5 day; <Consultant> Staff: ; <MEP> Staff: .5 day

SUBTASK 1.3 DEVELOP BUSINESS METRICS

Description: Establish how to measure progress toward the meeting of the business objectives of application integration.

Rationale: Application integration has the potential for improving the speed and accuracy of information processed by the business systems. Comparison needs to be made between the current paper processes and the new integrated processes. Measuring items which are affected by the speed and quality of information will help determine the actual benefits realized from the implementation.

Required Effort: Internal Staff: 1 day; <Consultant> Staff: 2 days

SUBTASK 1.4 DEVELOP PROJECT SCHEDULE

Description: Develop an implementation schedule with task durationís and milestones.

Rationale: Provides for a list of tasks with projected start and end dates with assigned resources. This schedule establishes the framework for the project's progress and accomplishments.

Required Effort: Internal Staff: 1 day; <Consultant> Staff: .5 day; <MEP> Staff: .25 day

SUBTASK 1.5 TRACK PROJECT PROGRESS

Description: Track the project's progress and completion of tasks.

Rationale: Tracking progress ensures the completion of project tasks and help identify any conditions which may cause delays or require changes in the project schedule.

Required Effort: Internal Staff: 5 days; <Consultant> Staff: 2 days; <MEP> Staff 2 days

TASK 2.0 MODIFY BUSINESS PROCESSES

SUBTASK 2.1 DEVELOP PROCEDURES FOR USING INTEGRATED EDI DATA

Description: Establish procedures for using incoming and outgoing EDI data

through mechanical file transfers.

Rationale: To gain the benefits of integrating EDI data into business applications, a process must be developed to move the data between the applications and update the appropriate files. The EDI system operator needs to be trained in the use of the file import and export capabilities of the <EDI SOFTWARE> package. Mechanical entry of data into the application and EDI systems calls

for changes in the way information is handled in that the EDI system operator's functions are more involved in monitoring, scheduling, and system performance evaluation rather than manual key entry.

Required Effort: Internal Staff: 4 days; <Consultant> Staff: 1 day; <MEP> Staff .5 day

SUBTASK 2.2 DEVELOP PROCEDURES FOR MOVING DATA BETWEEN UNIX AND PC PLATFORMS

Description: Establish procedures for moving data between the computers that host the EDI translator and the business applications.

Rationale: The interfacing of the business and EDI applications requires scheduling and processing changes. The choice of whether the processes will have mechanical or manual triggers will affect operations on both the EDI and business application users to ensure the data is moved in a timely manner with the least amount of manual effort. A procedure needs to be developed for transferring files between <EDI SOFTWARE> and the job shop control software for file import and export.

Required Effort: Internal Staff: 5 days; <Consultant> Staff: 1 day; <MEP> Staff .5 day

SUBTASK 2.3 TRAIN STAFF ON MODIFIED BUSINESS PROCESSES

Description: Train the staff that will operate the integrated system and use the information that the system provides.

Rationale: In order to exploit the benefits of the EDI to business application integration, the staff using and operating the systems need training on the new processes and procedures developed above. The training will cover the use of the EDI translator, the job shop control system business applications, the file transfer process between the packages, the file reformatting programs, the file transfer and interface programs, system maintenance, monitoring, auditing, and performance evaluation.

Required Effort: Internal Staff: 3 days; <Consultant>: 1 day

TASK 3.0 MAP EDI TO APPLICATION FORMATS

SUBTASK 3.1 EXTRACT 830 EXPORT FILE FORMAT FOR <EDI SOFTWARE>

Description: Determine the format and position of data elements in the 830 overlay for file export.

Rationale: Each overlay of the <EDI SOFTWARE> translator produces a unique file format translated from an EDI transaction. This format contains the all the data elements that are defined in the transaction overlay as used by the particular trading partner or industry group. The format generated can be represented as either a COBOL File Definition or a C Data Structure giving the location, length, and format of the data element in its specific output record. This allows for mapping of the Release to the order entry module of the job shop software.

Required Effort: Internal Staff: .25 day; <MEP> Staff: .1 day

SUBTASK 3.2 MAP 830 TO ORDER INPUT

Description: Determine how the data elements of the 830 overlay file correspond to the data elements of the job shop system order input file.

Rationale: Correspondence needs to be established between the data elements of the EDI and application files in order to pass the information between the systems. Mapping determines the relationship of the data element in the EDI 830 overlay file to its equivalent data element in the job shop control system order entry file. Once this relationship is established a program can be written to reformat the EDI system output to the order entry input.

Required Effort: Internal Staff: 1 day; <MEP> Staff: .5 day

TASK 4.0 DEVELOP REFORMATTING SOFTWARE

SUBTASK 4.1 DEVELOP RELEASE FILE REFORMAT PROGRAM

Description: Develop an application which can reformat the output of the <EDI SOFTWARE> program for input to the job shop system order module.

Rationale: Reformatting programs need to be developed to convert data elements from EDI formats to business application formats. The current job shop control package uses Business BASIC for customizing the applications or adding functionality/features to the system. Additionally, interface processes must be developed to start the file movement and reformatting.

Required Effort: Internal Staff: 5 days

TASK 5.0 TEST EDI TO APPLICATION INTERFACES

SUBTASK 5.1 UNIT TEST RELEASE TO ORDER ENTRY INTERFACE

Description: Test the ability to move data between the 830 output file and order input file.

Rationale: Determines if the release mapping and file transfer procedures are operating properly. This testing includes moving the files between the PC and UNIX platforms, reformatting the files from EDI to application format, and starting the update process for the order entry module.

Required Effort: Internal Staff: 3 days; <MEP> Staff: .5 day

SUBTASK 5.2 SYSTEM TEST EDI TO APPLICATION INTEGRATION

Description: Test the linkages and operations of the entire EDI to application interfaces and operations.

Rationale: After completion of the unit tests for releases and ship notices, the interfaces and processes need to be tested as they are to be used in production. This step proves the integrity and performance of the entire EDI, file transfer, and application links.

Required Effort: Internal Staff: 4 days; <MEP> Staff .5 days

TASK 6.0 PRODUCTION TURNOVER OF INTEGRATED SYSTEM

SUBTASK 6.1 CONFIRM ALL TURNOVER REQUIREMENTS ARE MET

Description: Ensure integrated system meets all functionality criteria for use in a production environment.

Rationale: The testing tasks are used to determine the functionality of the system. When all tests are successfully completed and functionality proven, then the system is ready for production turnover.

Required Effort: Internal Staff: 2 days

SUBTASK 6.2 START USING PRODUCTION DATA AND PROCESSES

Description: Use the integrated system for daily operations and processing of trading partner information.

Rationale: When the system meets the production turnover requirements as proven by the system tests, production use of the integrated EDI and business applications can begin. All the processes and procedures for using integrated data are enabled and manual processes terminated.

Required Effort: Internal Staff: 3 days

TASK 7.0 SUPPORT

SUBTASK 7.1 DEVELOP DATA ARCHIVING PROCEDURES

Description: Establish procedures for the archiving of translated and mapped business data.

Rationale: Data should be archived at every step where the format or content is changed. The three archiving points are the pure X12 transaction set, the formatted EDI input or output file, and the application formatted file. This should be worked into the standard system back-up procedures. Along with the archiving, policies and procedures also need to be developed for the removal of the EDI transactions after they no longer have business value.

Required Effort: Internal Staff: 2 days; <Consultant> Staff: .5 day

SUBTASK 7.2 DEVELOP AUDITING PROCEDURES

Description: Develop procedures for assuring the quality and timeliness of the data exchanged between the EDI translator and the business applications.

Rationale: The quality, timeliness, and usability of both EDI and application data need to be evaluated. The auditing procedures need to be developed to assess the ability to rely on the data produced by the EDI and application systems without manual analysis or intervention. Regular auditing of data and processes will show if any problems have developed and lead to speedy resolution.

Required Effort: Internal Staff: 4 days; <Consultant> Staff: 1.5 days

Detail Cost:

[This section is comprised of two table listing detail costs for Initial Implementation and On-going activities.]

EXAMPLE:

Programming:

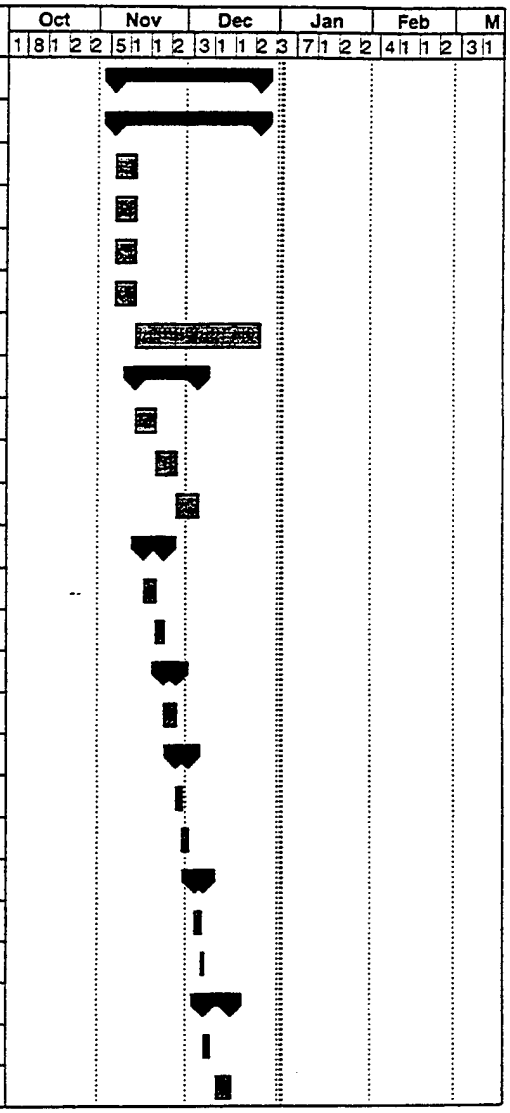
Initial Cost	Unit Cost
Release file reformat programming	$2000
Interface programming	$800–$1600

On-going Cost Items	Unit Cost/basis

Work Level and Schedule

[This section is a gannt chart of the detail task showing beginning and completion dates for each major task and its component subtasks. Columns are included for the time required for each participating organization in the project.]

ID	Task Name	Task#	CO.	MEP	CON
75	**EDI Integration**	**8**	**44**	**6.25**	**10**
76	**Project Management**	**8.1**	**7.75**	**3**	**5**
77	Establish Implementation Team	8.1.1	0.25	0.25	0.25
78	Determine Project Resources	8.1.2	0.5	0.5	0.5
79	Develop Business Metrics	8.1.3	1	0	2
80	Develop Project Schedule	8.1.4	1	0.25	0.25
81	Track Project Progress	8.1.5	5	2	2
82	**Modify Business Processes**	**8.2**	**12**	**1**	**3**
83	Develop Procedures for Using Integratec	8.2.1	4	0.5	1
84	Develop Procedures for Moving Data Be	8.2.2	5	0.5	1
85	Train Personnel on Modified Businees p	8.2.3	3	0	1
86	**Map EDI to Application Formats**	**8.3**	**1.25**	**0.75**	**0**
87	Extract 830 Exprot File Format for STX	8.3.1	0.25	0.25	0
88	MAP 830 to order Input	8.3.3	1	0.5	0
89	**Develop Software**	**8.4**	**5**	**0**	**0**
90	Develop Release File Reformat Program	8.4.1	5	0	0
91	**Test EDI to Application Interfaces**	**8.5**	**7**	**1.5**	**0**
92	Unit Test Release to Order Entry Interfac	8.5.1	3	0.5	0
93	System Test EDI to Application Integrati	8.5.3	4	0.5	0
94	**Production Turnover of Integrated System**	**8.6**	**5**	**0**	**0**
95	Confirm All Turnover Requirements Are	8.6.1	2	0	0
96	Start Using Production Data and Proces	8.6.2	3	0	0
97	**Support**	**8.7**	**6**	**0**	**2**
98	Develop Data Archiving Procedures	8.7.1	2	0	0.5
99	Develop Auditing Procedures	8.7.2	4	0	1.5



8.4 Appendix D: Process Observation Checksheet

I. 830 Receipt

1) Method of 830 transmission.	
2) Method of transmission to internal processing.	
3) Exception/ Change analysis method. • part number credibility • quantity and schedule credibility • changes to previous 830	
4) Method of changing values of 830 information.	

B. Internal Processing of 830 Information

1) Accuracy of material specification database. • Does a material specification database exist? • How accurate is the material specification database?	

2) If no material specification database exists, what is the alternate system? • reorder point? If yes, how are reorder points and quantities being determined? • other?	
3) Supplier lead time specifications. • Is accurate supplier lead time information contained in a vendor database?	
4) Inventory Accuracy. • how accurate are part number inventory levels in the inventory record system?	
5) Frequency and duration of processing.	

C. Sending of 830 material releases

1) Is the 830 used? • if not, what is used for purchasing materials?	
2) What is the interface between the internal system and the generation of the purchase document or 830? • electronic? • manual?	
3) Are there any modifications made to the data or other delays before release to suppliers? • Increase order size to take advantage of quantity discounts? • Correction of errors caused by internal system? • Final check of original 830 data?	
4) Method of sending 830 releases.	

8.5 Appendix E: Process Documentation Worksheet

Process Documentation Worksheet

Interviewer **Node Decomposition**
Interviewee **Node Name**

Functions	Inputs	Outputs	Mechanisms	Controls

8.6 Appendix F: Baseline Performance Summary Report

Date of Report: _____

Top ten cost drivers (list)

1. _____ 6. _____

2. _____ 7. _____

3. _____ 8. _____

4. _____ 9. _____

5. _____ 10. _____

Top ten time drivers

1. _____ 6. _____

2. _____ 7. _____

3. _____ 8. _____

4. _____ 9. _____

5. _____ 10. _____

Top ten quality drivers

1. _____ 6. _____

2. _____ 7. _____

3. _____ 8. _____

4. _____ 9. _____

5. _____ 10. _____

List analyses conducted:

_____

_____

8.7 Appendix G: Benchmark Guideline

The objective of this guideline is to describe current best practice regarding the MAP recommendations. These practices represent the desired outcome when implementing the recommendations. It is understood that individual situations and resource limitations will impact actual implementation.

This set of best practices was established for the companies in the MAP supply chain, and may not completely match other applications. Best practices are continuously changing as technology and business practices advance. This guideline describes best practices at the point of MAP implementation; late 1995.

This guideline is intended to describe what one would observe, in the best case, as business practices and technologies when participating companies implement the recommendations.

Recommendation 1: Two-way EDI

"All trading partners should make use of at least a minimum number of standard EDI transaction sets with their customers and suppliers."

Business objectives of EDI communications are measured over time

Business practices are established to measure progress toward the meeting of the business objectives of EDI communication.

Current EDI translation software is installed

Current version EDI translation software is installed on business computer system. The system is configured to send and receive EDI transactions with multiple trading partners with differing implementation conventions. The package has file import and export capabilities to interface with the manufacturing software, for future integration.

A Value Added Network (VAN) connection is established

A VAN connection is established. This VAN provides reliable and supported connectivity to each of the company's trading partners. The VAN is capable of connections to the Internet. The VAN's method of pricing is appropriate for the services used.

Users are trained in EDI translation software

Operators and backup persons have been trained on the features and operation of the EDI translation software. This training included installation, configuration, communication, adding and removing trading partners, updating with new overlays and log-ons, sending and receiving transactions, and other day-to-day operations.

Trading partner agreements exist with all trading partners

Trading partner agreements exist with all trading partners to provide evidence in case of disagreements. The agreements include defined scope of the trading partner relationship, increased enforcement of EDI transactions (to overcome the shortcomings of law), methods to share the liabilities related to communication errors and VAN problems, and expressed legal importance of EDI implementation forms. A trading partner profile has been completed and verified by both parties. The profile identifies transactions, versions, addresses, and distribution of charges.

Procedures exist for sending and receiving EDI transactions

Written procedures are established and maintained for incoming and outgoing EDI transactions. These procedures involve descriptions regarding the way documents and other information are interpreted and distributed within the organization.

EDI data archiving procedures exist

EDI transactions are archived off the workstation so they are available in case transactions need to be re-processed. This is part of standard system back-up procedures. Policies and procedures are also established to remove the EDI transactions after they no longer have business value.

Users are trained in EDI procedures and processes

Personnel are trained in the procedures of EDI business processes. This training includes sending, receiving, interpreting output, and processing input and output. The EDI system operator also performs communication and translation sessions to send and receive the additional transactions. Staff is trained in the interpretation of release data to provide the same input to the order processing module of the manufacturing software. The staff is also trained on the method to input Shipping Notices in the EDI software.

Process exists to add or delete trading partners

A documented and maintained procedure exists for adding or deleting trading partners. For adding trading partners, this process defines how transactions will be tested and then brought into production use.

Methods exist to identify and implement improvements in the EDI system

Methods exist to identify and implement improvements in the EDI system. These continuous improvement methods include resolving common problems, tracking industry trends, and building of supporting business cases.

Tested plans exist to recover from equipment, network, or software failures

Plans are established for operating after a major system failure. This plan includes alternative methods to communicate information and interface to the manufacturing software. After the cause of the failure has been identified and removed, the plan establishes the method to restore normal operations. The plan has been tested.

A procedure exists for monitoring the system's operational performance

A procedure exists to monitor the operational performance of the EDI system in day-to-day use. This testing identifies degraded performance and proactively resolves problems. This testing is intended to identify and resolve problems prior to failures that effect business operations.

Procedures exist to keep EDI system maintained

Procedures exist to maintain the EDI system. The maintenance include updating of software and hardware. This maintenance also include updating system documentation and training.

Critical applications and files are regularly backed up

Critical applications and files are regularly backed up. These backups have been tested, possibly as part of the disaster recovery plan.

Recommendation 2: E-mail

"E-mail should be used for non-EDI communication with trading partners, i.e. for exception and supplemental communication so long as its use will meet the immediate needs of the situation."

E-mail is readily available to all non-production users on their desktop/workplace environment

The E-mail system is an integrated application presented to the user as part of the standard computer interface. If this is a terminal to a central system, e-mail is a menu item. On a personal computer it is part of a suite such as MS Mail in MS Office, cc:Mail in Lotus Smart Suite, etc.

System is feature rich and user friendly

The feature set of the e-mail system includes automatic generation of reply addresses, forwarding capability, built-in text editing of outgoing messages, cut-and-paste with other applications, etc. User friendliness factors include meaningful on-line help, ease of error correction, familiar user interface, point-and-click selection, pull-down menus, etc.

Users are trained in the use of the e-mail system

Users are adequately trained in both the technical aspects of using the e-mail system and in the appropriate use of e-mail in the way they do work to use the system independently.

Users have appropriate level of documentation at their workplace

Each user has a user manual for the e-mail system at their workplace.

Corporate policy on e-mail use exists and is understood by users

A corporate policy on e-mail use includes allowed use's, a privacy statement, how mail is monitored, and the relationship to other forms of corporate communication. If Internet access is permitted, this policy states what services (i.e. what news groups are allowed), graphics imports, etc., are permitted. The policy also addresses the issues of how long messages are stored, internal distribution methods and examples of what is considered proper means of expressions (i.e. no flaming, pornographic or racial jokes, etc.).

Business practices incorporate the use of e-mail

Standard internal and external business practices and procedures are defined to leverage the proper use of e-mail.

Trouble reporting procedures exist and are known by users

There is a well established, fully documented procedure for reporting e-mail problems to a central location to insure rapid resolution and thorough documentation of problems.

System has sufficient resources for use by all staff members

Resources include adequate disk space for message storage, sufficient user licenses for all users, adequate computer memory for concurrent usage, large enough number of ports for internal and external traffic, etc. Resource levels are sufficient to insure timely delivery of messages.

System supports transfer of text and binary data

The system supports the inclusion or attachment of binary data and files when sending or receiving an e-mail message.

System provides aliasing capabilities including mail lists

Aliases allow for delivery of messages to individuals other then the addressee. Mail list provides an established electronic distribution via a single entry in the address field.

Internal e-mail system is connected to external e-mail service

The internal system is connected to an external network so that outside e-mail is transmitted with no apparent difference, other than the address, from the users' viewpoint. Conversely, externally created e-mail coming into the organization is delivered to the recipient in the same manner as internally generated messages.

System supports store and forward philosophy for external connection

Store and forward system allows for the holding of mail when the receiving system or network may be unavailable due to connectivity problems. For internal e-mail, this holds the case when the internal hardware system consists of multiple servers and the receiving server is down. In the case of external e-mail, if the network connection is broken for some reason, the message is stored until connectivity was re-established.

System supports IP and X.400 addressing scheme to remote partners

System supports Internet Protocol (IP) addressing, the format use by most UNIX based systems and the Public Internet; and X.400 format, a longer address format that uses the first and last names, country, state, city, company, department, etc., or some subset of this information. If the external network service provider translates these two formats, it is only necessary for the local system to transmit a single address.

Domain name exists for organization for external connectivity

External connectivity supports gateways adequate to contact all trading partners

The external mail service provider has gateways to the service provider network of all trading partners. The gateway connectivity is as seamless as possible to the end users.

System provides for security of message content and computing environment intrusion

The security of message content is guaranteed. The system does not alter message body content and insures delivery to the proper recipient with reasonable assurance that no one else can view the message. E-mail system administrators can view all mail and therefore understand their role and respect the confidentiality of messages. Systems connected directly to external services provide for adequate system level security to minimize the possibility of e-mail being used as a vehicle for breaking into the computing environment.

Availability is on a 7 X 24 basis

The system is available 7 days a week, 24 hours per day with scheduled outages held to a minimum. Activities, such as down time for backups, preventive maintenance, etc., are planned in advance with the schedule distributed to the user community in a timely manner.

Technical support exists for internal and external e-mail systems and connectivity

Support staff, internal or contracted, are trained in the support and maintenance of the e-mail system and have a level of knowledge of the external connection sufficient to work with the service provider to determine the nature of any external communication problems.

Configuration parameters are part of maintained computer environment including standard backups

The e-mail system configuration files, user message logs and queues, etc. are part of routine backup procedures and standard system administration activities. System logs are reviewed daily for delivery problems, potential security problems, capacity problems, etc.

Configuration parameters and setup procedures are well documented and current

Administration logs are kept of e-mail system additions, deletions and changes. Procedures for administering the system are well documented and kept in a secure but accessible location.

E-mail system has the same robustness as other computer-based systems in the firm

The e-mail system meets all standard systems requirements for robustness. These include scalability (as the user community and usage grows), recovery in the case of catastrophic systems failure, being reasonably bug free with a good maintenance record and upgradablity.

Problem logs are maintained for both internal and external trouble reports

Problem report logs are maintained that detail individual trouble reports, their cause, and subsequent resolution. These include both the internal and the external components of the total e-mail system.

Recommendation 3: Integrated EDI

"Internal business systems should be developed or modified to make use of EDI transaction sets directly and automatically."

Business objectives of EDI communications are measured over time

Business practices are established to measure progress toward the meeting of the business objectives of EDI communication.

Procedures exist for integrated EDI transactions

Written procedures are established and maintained for using incoming and outgoing EDI data through file transfers. The procedure defines the method to move the data between the applications and computers to update the appropriate files. The EDI system operator is trained in the use of the file import and export capabilities of the EDI software package.

Users are trained in integrated EDI procedures and processes

Personnel are trained in the procedures of integrated EDI business processes. This training includes the use of the EDI translator, the job shop control system business applications, the file transfer process between the packages, the file reformatting programs, the file transfer and interface programs, system maintenance, monitoring, auditing, and performance evaluation.

Overlays are configured for each transaction of each trading partner

Overlays are configured for each transaction of each trading partner. These overlays are used to map data elements in the transaction sets to fields in the manufacturing control software.

EDI data archiving procedures exist

Translated and mapped EDI transactions are archived so they are available in case transactions need to be re-processed. Data is archived at every step where the format or content is changed. The archiving points include the pure X12 transaction set, the formatted EDI input or output file, and the application formatted file. This procedure is incorporated into the standard system back-up procedures. Along with the archiving,

policies and procedures also exist for the removal of the EDI transactions after they no longer have business value.

Procedures exist for assuring the quality and timeliness of the data exchanged between the EDI translator and the business applications

The quality, timeliness, and usability of both EDI and application data is assured through audits. The auditing procedures exists to assess the ability to rely on the data produced by the EDI and application systems without manual analysis or intervention. Regular audits of data and processes identify problems that may have developed and lead to speedy resolution.

Benchmark EDI Internal Business Processes

The following flow diagram, Benchmark Model of Electronic Data Interchange and Internal Business Processes, illustrates the best practices performed to convert EDI materials requirements into finished goods requirements. The distinguishing feature of the best practice case is 24 hour cycle time from receipt of the incoming 830 material release to transmission of the outgoing 830 material release to suppliers. This quick cycle time is enabled by efficient internal processes that minimize non value added work. All manual review and manipulation of data is kept to a minimum and handled on an exception basis. The reviewer is primarily concerned with significant and unanticipated changes in volume. Procedures exist for handling such exceptions. Additionally, internal information systems maintain accurate information regarding inventory levels, bills of material, and supplier lead times in order to insure a high quality output from MRP and master scheduling systems.

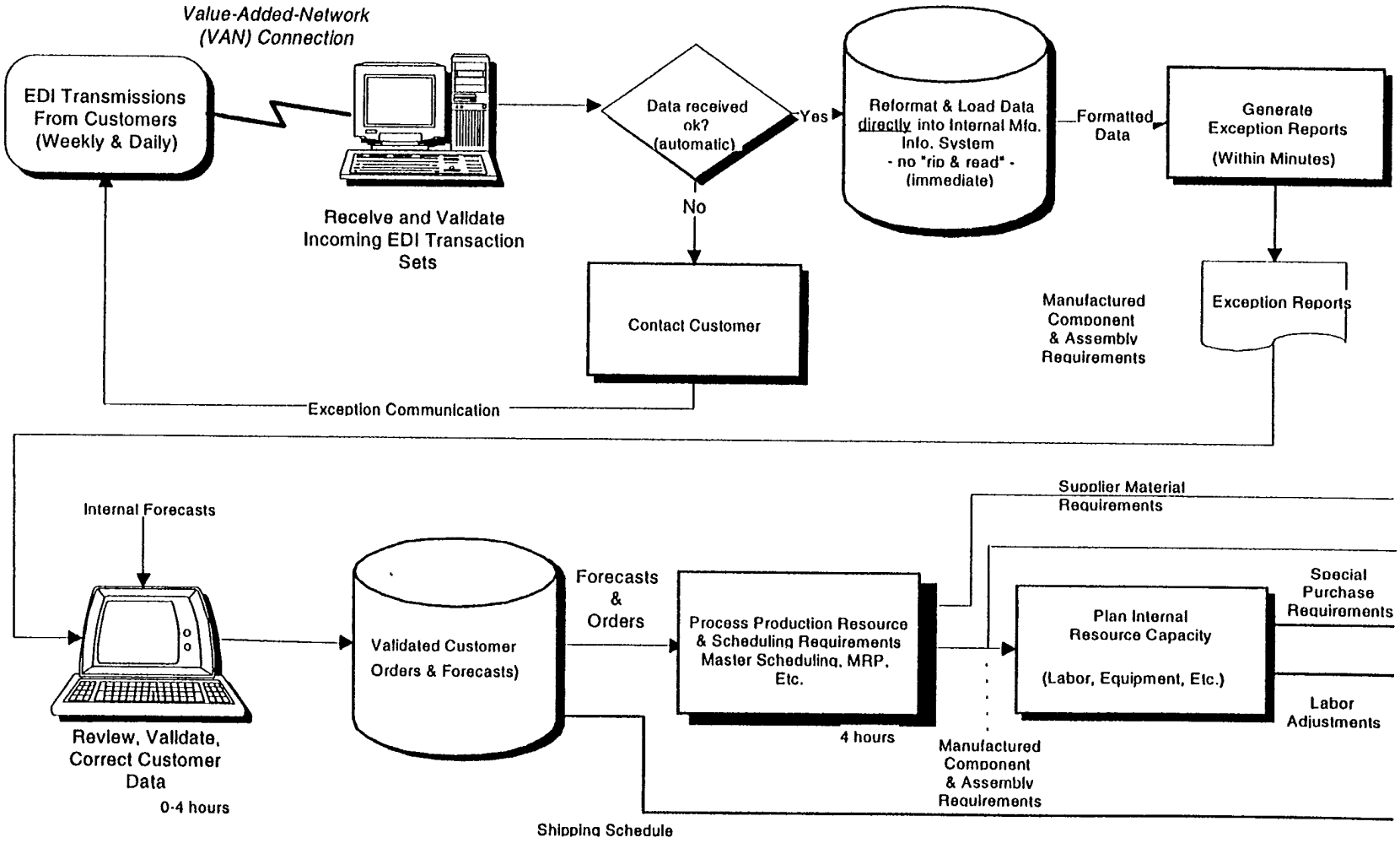


Figure 8-1. Benchmark Model of Electronic Data Interchange and Internal Business Process

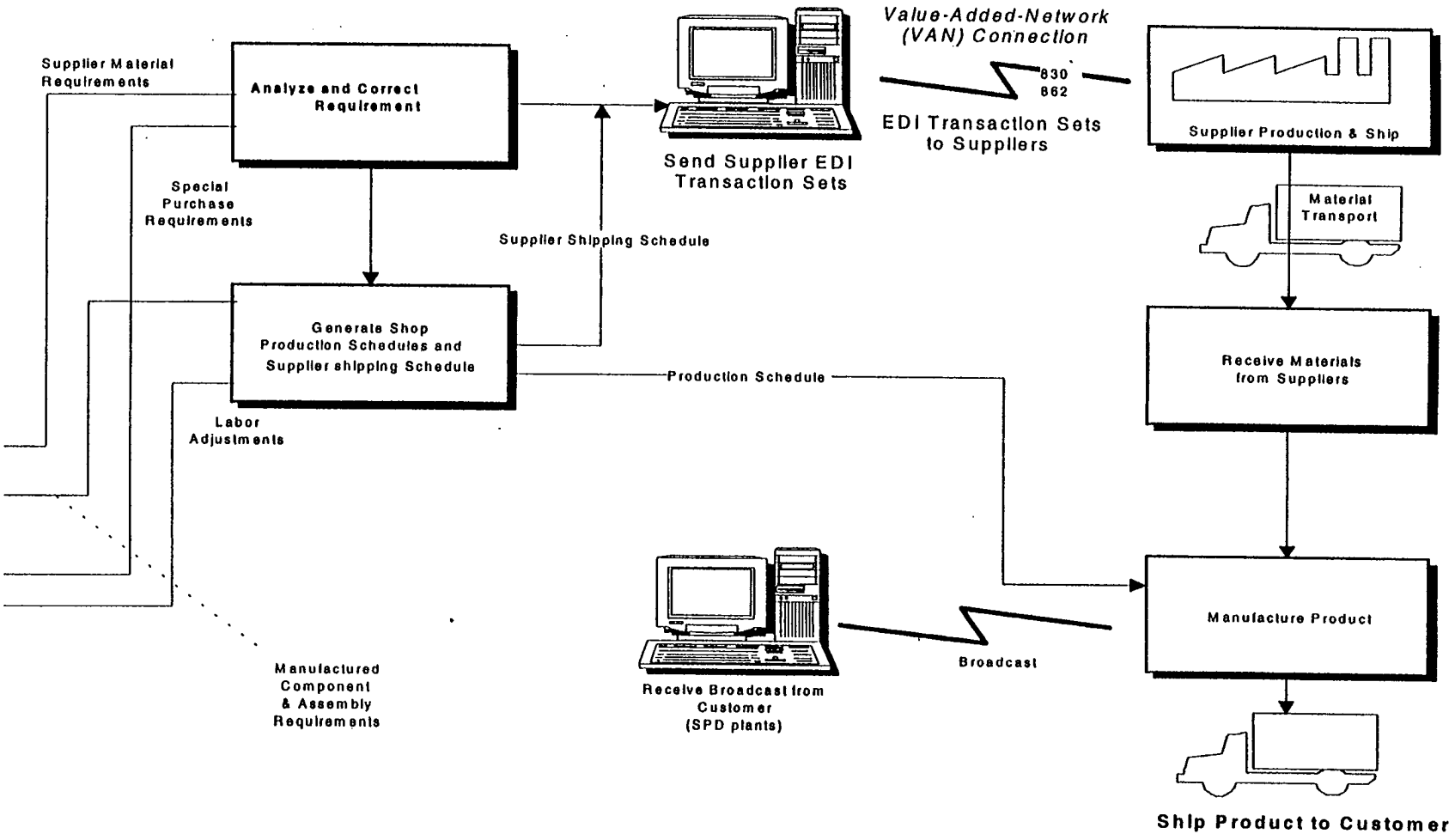


Figure 8-2. Benchmark Model of Electronic Data Interchange and Internal Business Process

Sample Blank Template

Costs

Personnel Costs	$ _____
Training Costs	$ _____
Software and Services Costs	$ _____
Hardware Costs	$ _____
VAN charges	$ _____
Total Costs	$ _____

Benefits

Fewer Errors	$ _____
Productivity improvements	$ _____
Inventory savings	$ _____
Premium freight savings	$ _____
Unplanned setups	$ _____
Customer satisfaction	$ _____
Total Benefits	$ _____